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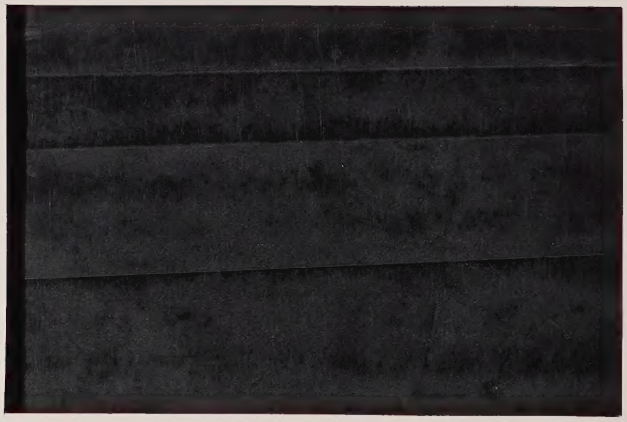

CALIFORNIA INSTRUMENTS
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October, 1972

INSTRUCTION MANUAL

MODEL 8440

DIGITAL PANEL

METER

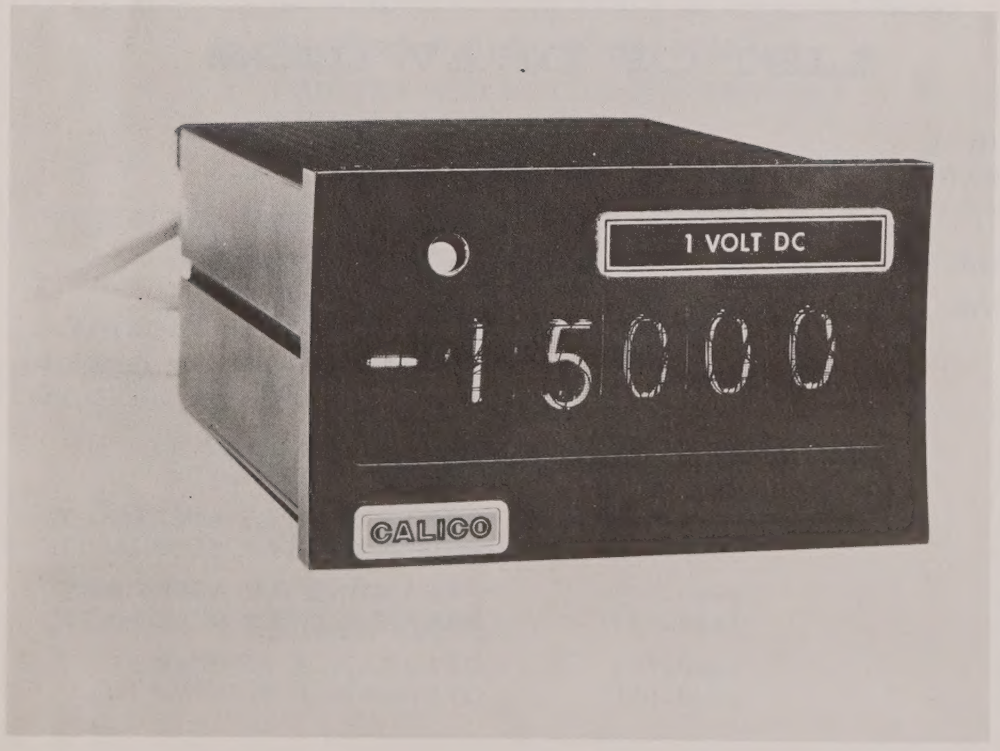


FIGURE 1-1

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
1-1	MODEL 8440 PHOTOGRAPH	Frontispiece
2-1	INPUT CONNECTOR WIRING	5
3-1	GROUND LOOP BLOCK DIAGRAM	10
3-2	ISOLATED GROUND OPTION BLOCK DIAGRAM	10
3-3	ASYNCHRONOUS SYSTEM BLOCK DIAGRAM	11
3-4	SYNCHRONOUS SYSTEM BLOCK DIAGRAM	12
4-1	MODEL 8440 BLOCK DIAGRAM	14
4-2	MODEL 8440 TIMING DIAGRAM	16
5-1	AC COMMON MODE REJECTION TEST CIRCUIT	22
5-2	DC COMMON MODE REJECTION TEST CIRCUIT	23
5-3	INPUT IMPEDANCE TEST CIRCUIT	23

TABLE	TITLE	PAGE
2-1	PRINT OUTPUT, DECIMAL POINT WIRING	7
3-1	DECIMAL POINT PIN ALLOCATION	11

LIST OF DRAWINGS

ASSEMBLY REFERENCE DESIGNATOR	DRAWING NUMBER	TITLE
NONE	C8440-900	OUTLINE DRAWING
NONE	8440-400	MAIN ASSEMBLY
	8440-074	INTERCONNECT DIAGRAM
A1	8440-700	DIGITAL AND LOGIC ASSEMBLY
A1	8440-070	DIGITAL AND LOGIC SCHEMATIC
A2	8440-701	ANALOG ASSEMBLY
A2	8440-071	ANALOG SCHEMATIC
A3	8440-702	POWER SUPPLY ASSEMBLY
A3	8440-072	POWER SUPPLY SCHEMATIC
A4	8440-703	PREAMPLIFIER ASSEMBLY
A4	8440-073	PREAMPLIFIER SCHEMATIC
A5	8440-704	OVERRANGE ASSEMBLY
A5	8440-070	OVERRANGE SCHEMATIC

TABLE OF CONTENTS

		PAGE
GENERAL DESCRIPTION		
1.1	INTRODUCTION	1
1.2	DESCRIPTION	1
1.3	MODEL NUMBER DESCRIPTION	1
1.4	OPTIONAL FEATURES	1
1.5	EQUIPMENT SUPPLIED	1
1.6	ACCESSORY EQUIPMENT	2
INSTALLATION AND OPERATION		
2.1	UNPACKING	4
2.2	MECHANICAL INSTALLATION	4
2.3	CONNECTOR WIRING	4
2.4	ACCEPTANCE TEST PROCEDURE	8
APPLICATION		
3.1	GENERAL	9
3.2	GROUND LOOPS IN SYSTEMS APPLICATIONS	9
3.3	DECIMAL POINT PROGRAMING	10
3.4	PRINTER AND AUTOMATIC SYSTEMS APPLICATIONS	11
3.5	READ AND HOLD AND BCD OUTPUTS	12
THEORY OF OPERATION		
4.1	GENERAL	15
4.2	DETAILED CIRCUIT DESCRIPTION	15
4.2.1	INPUT AMPLIFIER	15
4.2.2	PRECISION REFERENCE AMPLIFIER	17
4.2.3	4 CHANNEL MULTIPLEXER	17
4.2.4	INTEGRATOR	17
4.2.5	ZERO DETECTOR	18
4.2.6	LOGIC	18
4.2.7	POWER SUPPLY	19

CALIBRATION AND TEST PROCEDURE PAGE

5.1 CALIBRATION PROCEDURE 21
5.2 TEST PROCEDURE 21

MAINTENANCE AND TROUBLESHOOTING

6.1 GENERAL MAINTENANCE 26
6.2 TROUBLESHOOTING 26

CIRCUIT DIAGRAM

7.1 GENERAL 29
7.2 REFERENCE DESIGNATIONS 29

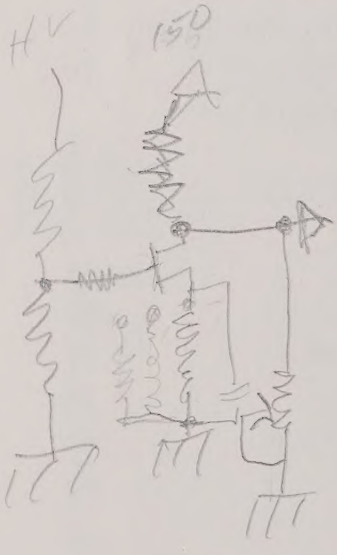
REPLACEMENT PARTS

8.1 GENERAL 30
8.2 ORDERING INFORMATION 30

PARTS LIST

APPENDIX A

CODE LIST OF MANUFACTURERS



SPECIFICATIONS

MODEL 8440 DIGITAL PANEL METER

FULL SCALE RANGES: (One only as determined by Model Number of Unit)	0 to ±1.4999 volts DC 0 to ±14.999 volts DC 0 to ±149.99 volts DC
ACCURACY: (After 30 minutes warm up) At 25°C for 8 hours: At 15 to 35°C for 30 days:	 ±0.01% of reading ±1 digit ±0.02% of reading ±1 digit
RESOLUTION:	1 digit
LINE VOLTAGE COEFFICIENT:	±1 digit for a ±10% change in the line voltage
INPUT IMPEDANCE:	10,000 megohms (nominal) on a 1.5 volt range 10 megohms (nominal) on 15 and 150 volt range
NORMAL MODE REJECTION:	40 db at 60 Hz
COMMON MODE REJECTION:	80 db at DC to 60 Hz (based on 100 μV/digit sensitivity)
INPUT BIAS CURRENT:	100 picoamperes nominal
SAFE INPUT OVERLOAD:	10,000% of range (but not to exceed 500 VDC)
DIGITIZING TIME:	300 milliseconds maximum
READING RATE:	3 readings per second
AVERAGE TEMPERATURE COEFFICIENT: (From 0°C to 55°C)	 ±0.002% of full scale/°C
AMBIENT OPERATING TEMPERATURE RANGE:	0 to 55°C

STORAGE TEMPERATURE RANGE:	-20 + 85°C
INPUT POWER	115 or 230 volts AC ±10% 13 watts maximum
INPUT FREQUENCY:	50 to 400 Hz
BCD OUTPUT:	1-2-4-8 positive "1" state- TTL LOGIC
SIZE:	2.13 x 3.66 x 5.22
NET WEIGHT:	38 ounces
SHIPPING WEIGHT:	Less than 5 pounds

Specifications apply when tested in accordance with standard CALICO test procedure.

GENERAL DESCRIPTION

1.1 INTRODUCTION

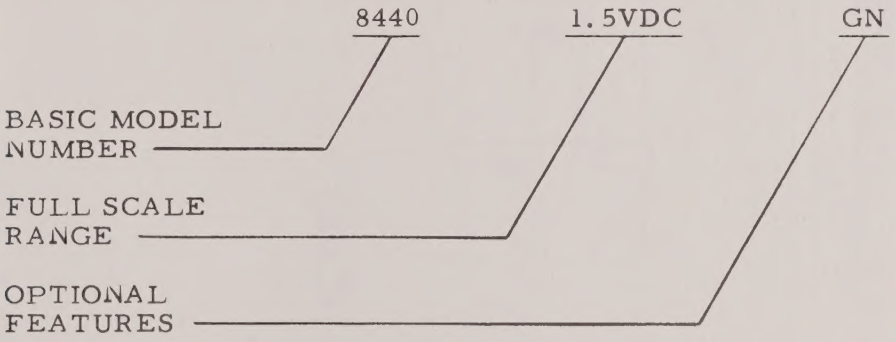
This instruction manual contains information on the installation, operation, calibration and maintenance of the CALICO Model 8440 Digital Panel Meter. A detailed theory of operation is included as an aid to maintenance personnel. A photograph of the instrument is shown in Figure 1-1.

1.2 DESCRIPTION

The CALICO Model 8440 Digital Panel Meter is a precision digital DC voltmeter. It provides BCD outputs and "READ and HOLD" for use in systems applications.

1.3 MODEL NUMBER DESCRIPTION

The following is a description of the complete model number for a CALICO Model 8440 Digital Panel Meter.



1.4 OPTIONAL FEATURES

1.4.1 OPTION G: This option provides isolated grounds between the analog input low and the BCD output common.

1.4.2 OPTION N: This option replaces the neon, negative only, display with a "±" neon display tube, and replaces the neon "1" in the 10,000's digit with a "0, 1" neon display tube.

1.5 EQUIPMENT SUPPLIED

The unit is shipped with an instruction manual and an 8440-207 panel mounting bracket.

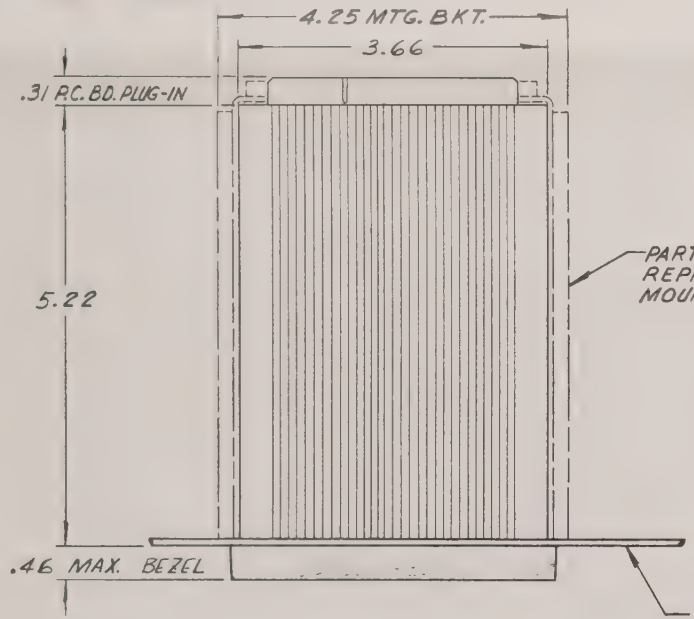
1.6 ACCESSORY EQUIPMENT

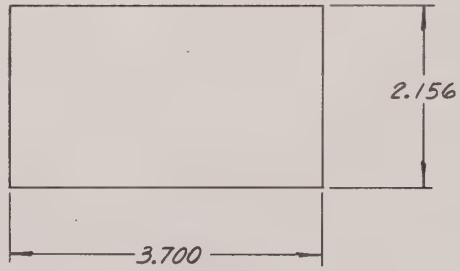
The following accessory equipment is available for use with the Model 8440 Digital Panel Meter:

1.6.1 Winchester 8BD18S-13. This mating connector is used to supply AC line power and analog signal inputs to the Model 8440 Digital Panel Meter.

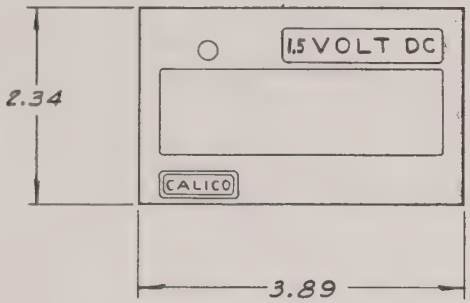
1.6.2 Winchester 8BD18S. This mating connector is used to supply connection to the BCD outputs and to the decimal programming for the Model 8440 Digital Panel Meter.

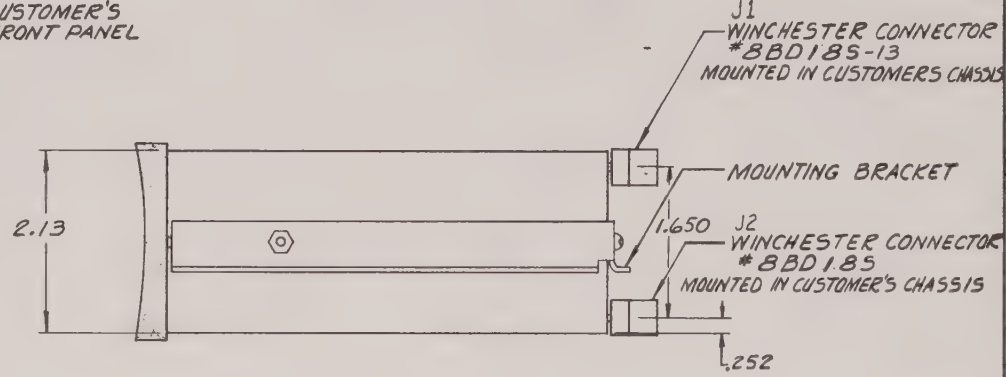
1.6.3 CALICO 8440-800. This is a pre-wired connector with hood assembly that provides AC line power and analog signal inputs to the Model 8440 Digital Panel Meter.





RECOMMENDED PANEL CUT-OUT FOR PANEL METER





REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

NOTES: (UNLESS OTHERWISE SPECIFIED)

DIM IN INCHES TOLERANCES .XXX ± .010 .XX ± .03 X° ± 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓

DWG SIZE C

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TITLE: OUTLINE DRAWING DIGITAL PANEL METER

MODEL 8440 & 8430

DASH NO	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

RELEASE

CHECKER 9/6/78 PURCHASING

DESIGN PROJ ENGR

DRFTSMN 7/20/78 CHF ENGR

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

DWG NO. C8440-900 REV \

SCALE 1/1 SHEET 1 OF 1

C8440-900 \

CALICO F-368

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

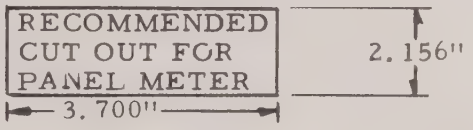
on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections.

2.1 UNPACKING

The panel meter is shipped in a cardboard shipping container with a protective inner packing. DO NOT DESTROY the packing container until the unit has been inspected for possible damage in shipment.

2.2 MECHANICAL INSTALLATION

The CALICO Model 8440 Digital Panel Meter is designed to mount in a rectangular panel opening 2.156 inches high by 3.700 inches wide.



The unit inserts through the panel opening and the mounting bracket, fastens to the unit from behind the panel, thus leaving no mounting hardware visible from the front panel.

2.3 CONNECTOR WIRING

The CALICO Model 8440 Digital Panel Meter uses two mating connectors. The first is the AC POWER and ANALOG INPUT Connector. The second connector provides the BCD outputs, decimal programming, and READ and HOLD.

2.3.1 AC POWER and ANALOG INPUT

See Figure 2-1 for pin allocations.

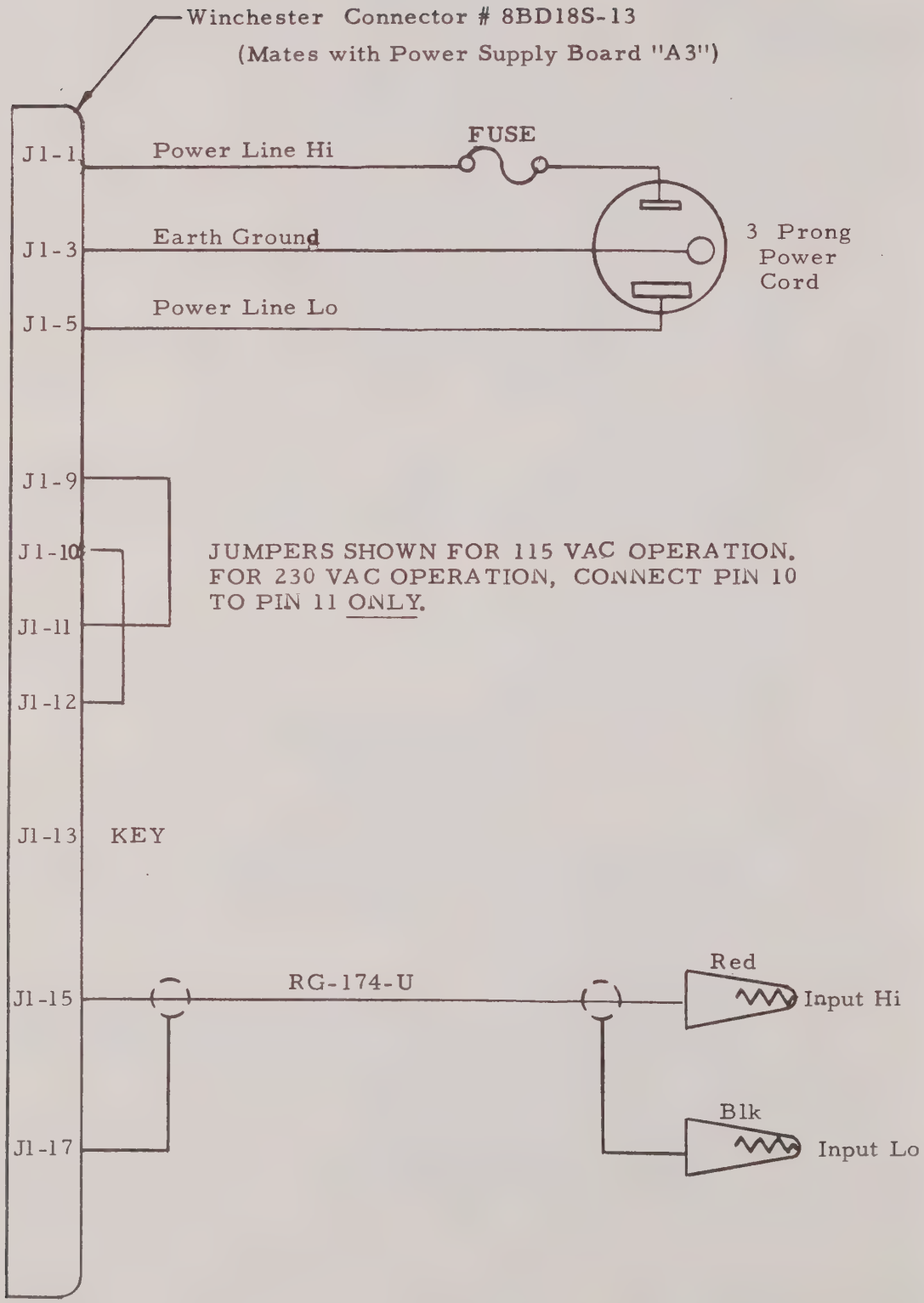


Figure 2-1 Wiring Diagram for Model 8440
AC Line Power and Signal Input Connector

2.3.1.1 ANALOG INPUT

Connect the high side of the input signal to PIN 15 of the mating connector. Connect the low side of the input signal to PIN 17. If the input signal leads are very long, or if the noise levels are extremely high, it is desirable to use a single conductor shielded wire for the high input. The shield of the shielded wire should be used for the low input lead.

2.3.1.2 AC POWER

2.3.1.2.1 POWER CORD and FUSE

Connect the high side of the AC power line to pin #1 in series with a 1/8 ampere slow blow fuse for 115 VAC or a 1/16 ampere slow blow fuse for 230 VAC operation. Connect the low side of the power line to pin #5. Connect the power ground to pin #3.

2.3.1.2.2 115/230 volt PROGRAMMING

For 115 volt AC operation connect pin #9 to pin #11 and connect pin #10 to pin #12.

NOTE

For 115 VAC operation insert a 1/8 ampere slow blow fuse in series with pin #1.

For 230 volts AC operation connect pin #10 to pin #11. (no connection to pins 9 and 12)

NOTE

For 230 VAC operation insert a 1/16 ampere slow blow fuse in series with pin #1.

2.3.2 BCD OUTPUT CONNECTOR

Table 2-1 contains a list of pin allocations for the BCD output connector. For a detailed explanation of their operation refer to the applicable application note under section 3.0 of this instruction manual.

TABLE 2-1

PRINT OUTPUT, DECIMAL POINT

PIN ALLOCATION CHART

PIN #	FUNCTION	PIN #	FUNCTION
J2-1	Output Common	J2-A	Overload "1"
J2-2	Print Output	J2-B	1000's "4"
J2-3	Encode Input	J2-C	1000's "2"
J2-4	Time Base Output	J2-D	1000's "1"
J2-5	Negative Polarity Output	J2-E	1000's "8"
J2-6	10,000's "1"	J2-F	100's "4"
J2-7	Positive Polarity Output	J2-H	100's "2"
J2-8	10,000's "T"	J2-J	100's "8"
J2-9	1000's Left Decimal Point	J2-K	100's "1"
J2-10	Not Used	J2-L	10's "4"
J2-11	1000's Right Decimal Point	J2-M	10's "2"
J2-12	100's Left Decimal Point	J2-N	10's "8"
J2-13	100's Right Decimal Point	J2-P	10's "1"
J2-14	10's Left Decimal Point	J2-R	1's "4"
J2-15	Not Used	J2-S	1's "2"
J2-16	10's Right Decimal Point	J2-T	1's "8"
J2-17	1's Left Decimal Point	J2-U	1's "1"
J2-18	Not Used	J2-V	1's Right Decimal Point

Connector J2 is a Winchester # 8BD18S
(Mates with Digital and Logic Board "A1")

2.4 ACCEPTANCE TEST PROCEDURE

Inspect the unit for any possible shipping damage immediately upon receipt. If any damage is evident, notify the carrier. Do not return the instrument to the factory without prior approval. If the unit appears to be in good condition, perform the following:

After wiring the signal input (Section 2.3.1.1) and the AC line power (Section 2.3.1.2), the unit may be tested in accordance with the following:

a) Connect a wattmeter between the AC power input to the digital panel meter and the AC line. Turn the unit on and check that the power does not exceed 13.0 watts. Allow 30 minutes for the digital panel meter to warm-up. Check that the digital panel meter indicates zero volts with the signal input leads shorted together. Adjust the front panel ZERO control, located under the range identification tag, if required.

b) Apply a known negative polarity DC voltage at approximately 95% of full scale and check that the display reads the voltage within ±2 digits. If the unit does not read the known voltage to this accuracy, and the known voltage is accurate to ±0,005 per cent, the unit may be adjusted by use of the -CAL control located on the front panel, under the range identification tag.

c) Apply a positive polarity DC voltage at approximately 95 per cent of full scale and check that the display indicates the voltage within ±2 digits. If the unit does not read the known voltage to this accuracy and the known voltage is accurate to ±0.005% the unit may be adjusted by use of the "+CAL" control located on the front panel, under the range identification tag.

d) Increase the input until the display reads 15000. Check that the overload indicator illuminates.

3.1 GENERAL

The CALICO Model 8440 Digital Panel Meter is a high reliability precision instrument designed to be very forgiving of adverse applications and environments. Like any precision instrument the CALICO Model 8440 Digital Panel Meter will deliver its best performance under good operating conditions. As an aid to achieving optimum performance and reliability under actual operating conditions, the following is a list of application hazards which may degrade the performance or the reliability of this instrument:

a) TEMPERATURE

When installing a CALICO Model 8440 Digital Panel Meter, careful consideration should be given to the actual ambient temperature. Because of the small size of this unit, there is a temptation to mount it in a confined area. The CALICO Model 8440 consumes approximately 11 watts of power. Therefore mounting this unit in a confined area without adequate ventilation can produce actual ambient temperatures as high as 60 to 70°C. Careful consideration to the actual ambient temperature will produce improved performance and reliability.

b) HUMIDITY AND CHEMICAL VAPORS

Many "Process Control" applications produce high humidity and/or chemical vapor as a by-product. Since the CALICO Model 8440 Digital Panel Meter is not hermetically sealed, prolonged exposure to this type environment may cause permanent damage to the instrument.

c) AC POWER LINE TRANSIENTS

The CALICO Model 8440 Digital Panel Meter is designed to be very forgiving of large line transients. However, some line transients such as caused by arc welders and large electro-magnets may exceed the amplitude of the line voltage, and are beyond the capability of the instrument. When this occurs it is advisable to operate the instrument from a separate power line.

3.2 GROUND LOOPS IN SYSTEM APPLICATIONS

When connecting the CALICO Model 8440 Digital Panel Meter (without isolated ground option) for systems applications, considerable caution should be used to avoid ground loops. The most common source of ground loops occur when the input is operating from a grounded voltage source and the BCD outputs are driving a grounded printing device. Figure 3-1 on the following page illustrates a typical installation where a ground loop is present. The generator E_{cm} represents a source of common mode voltage, which in turn, gives rise to ground currents.

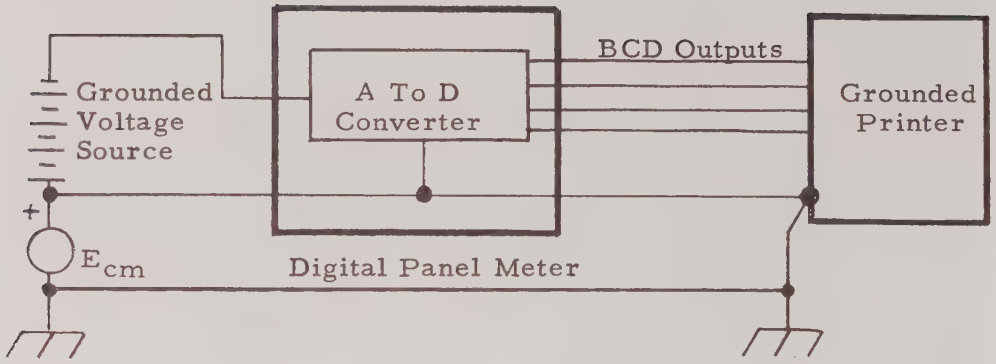


FIGURE 3-1

If floating the voltage source or printing device is not possible, then the CALICO Model 8440 Digital Panel Meter with option G should be used in the system. Option G provides isolated grounds as shown in Figure 3-2.

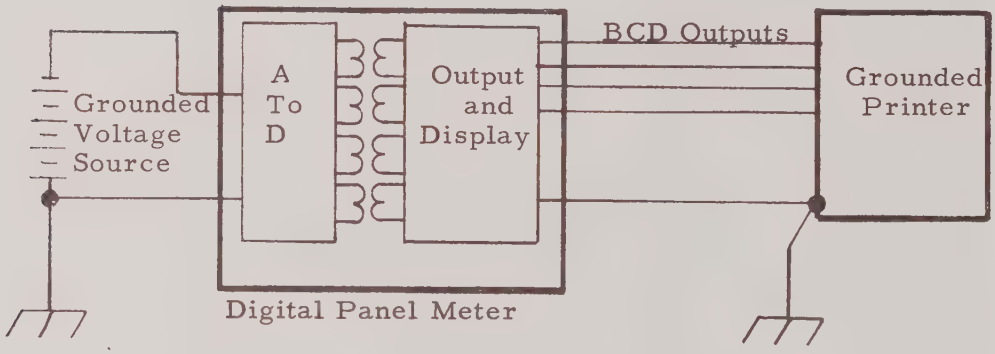


FIGURE 3-2

With this option the input low may be driven with respect to the output common up to ±100 volts DC or peak AC.

3.3 DECIMAL POINT PROGRAMING

Both the left and right decimal points for each display tube are available at the BCD OUTPUT connector. See Table 3-1 for Pin Allocations. Any of these decimal points may be activated by connecting the appropriate output pin to pin 1 through a 100KΩ 1/4W resistor.

The CALICO Model 8440 Digital Panel Meter is operated at 3 conversions per second from its own internal time base. The printing device is driven from an external clock. This clock is set to deliver a print command at some fixed interval of time, for example, 1 print every 10 seconds. Since the BCD output lines from the CALICO Model 8440 Digital Panel Meter are taken off after the storage register, the data present at the output is always valid.

3.4.1.2 SYNCHRONOUS SYSTEM

A block diagram for a synchronous system is illustrated in Figure 3-4. In this type of system each unit in the system is allowed to complete its cycle before the system is advanced to the next stage. This eliminates the need for a complex programmer to control the system sequence.

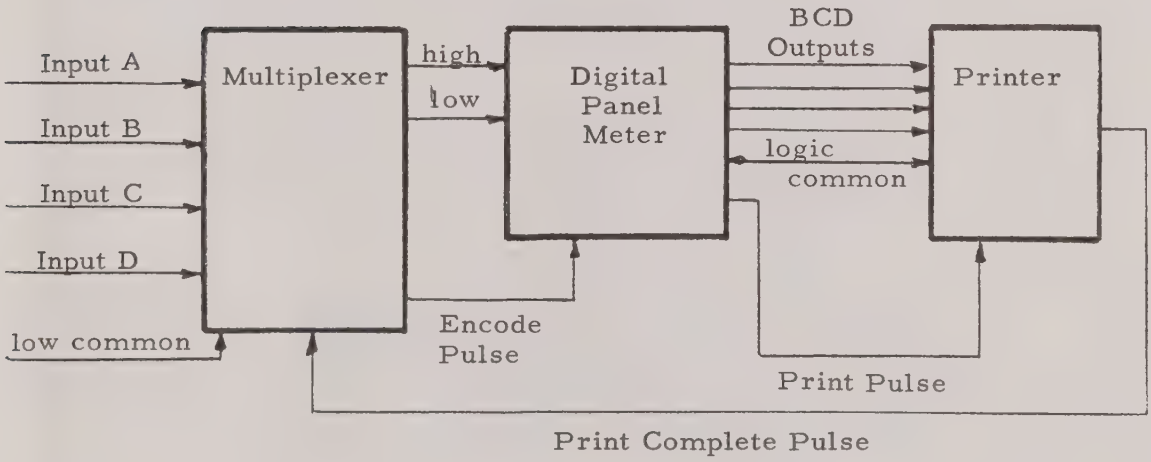


FIGURE 3-4

The system is started with a pulse into the multiplexer. The multiplexer scans channel A and allows time to stabilize, then sends an encode pulse to the panel meter. The panel meter encodes and displays the reading and then sends a print pulse to the printer. The printer goes through its print cycle then sends a print complete pulse to the multiplexer. This advances the multiplexer to channel B, and starts the entire process over again.

3.5 READ AND HOLD AND BCD OUTPUTS

3.5.1 BCD OUTPUTS

The BCD outputs are coded in a 1-2-4-8 positive "1" state format. A "0" output is between 0 and +.4V. A "1" output is a minimum of +2.4V.

TABLE 3-1	
DECIMAL POINT PIN ALLOCATION	
PIN #	FUNCTION
J2-1	OUTPUT COMMON
J2-9	1000's LEFT DECIMAL POINT
J2-11	1000's RIGHT DECIMAL POINT
J2-12	100's LEFT DECIMAL POINT
J2-13	100's RIGHT DECIMAL POINT
J2-14	10's LEFT DECIMAL POINT
J2-16	10's RIGHT DECIMAL POINT
J2-17	UNIT'S LEFT DECIMAL POINT
J2-V	UNIT'S RIGHT DECIMAL POINT

3.4 PRINTER AND AUTOMATIC SYSTEMS APPLICATIONS

3.4.1 GENERAL

The CALICO Model 8440 Digital Panel Meter has the built-in capability to be compatible with a wide variety of systems applications. This explanation covers only two of the more common types of systems.

3.4.1.1 ASYNCHRONOUS SYSTEM

A block diagram for an asynchronous system is illustrated in Figure 3-3. This is the simplest system to implement, because it requires no timing sequence or feedback. The usual purpose of this type of system is to supply permanent data on a single input parameter over long periods of time.

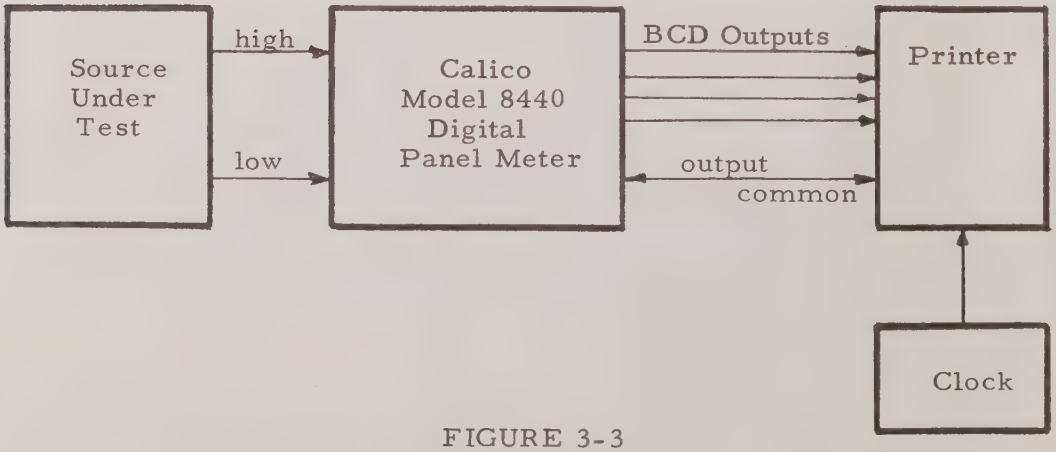


FIGURE 3-3

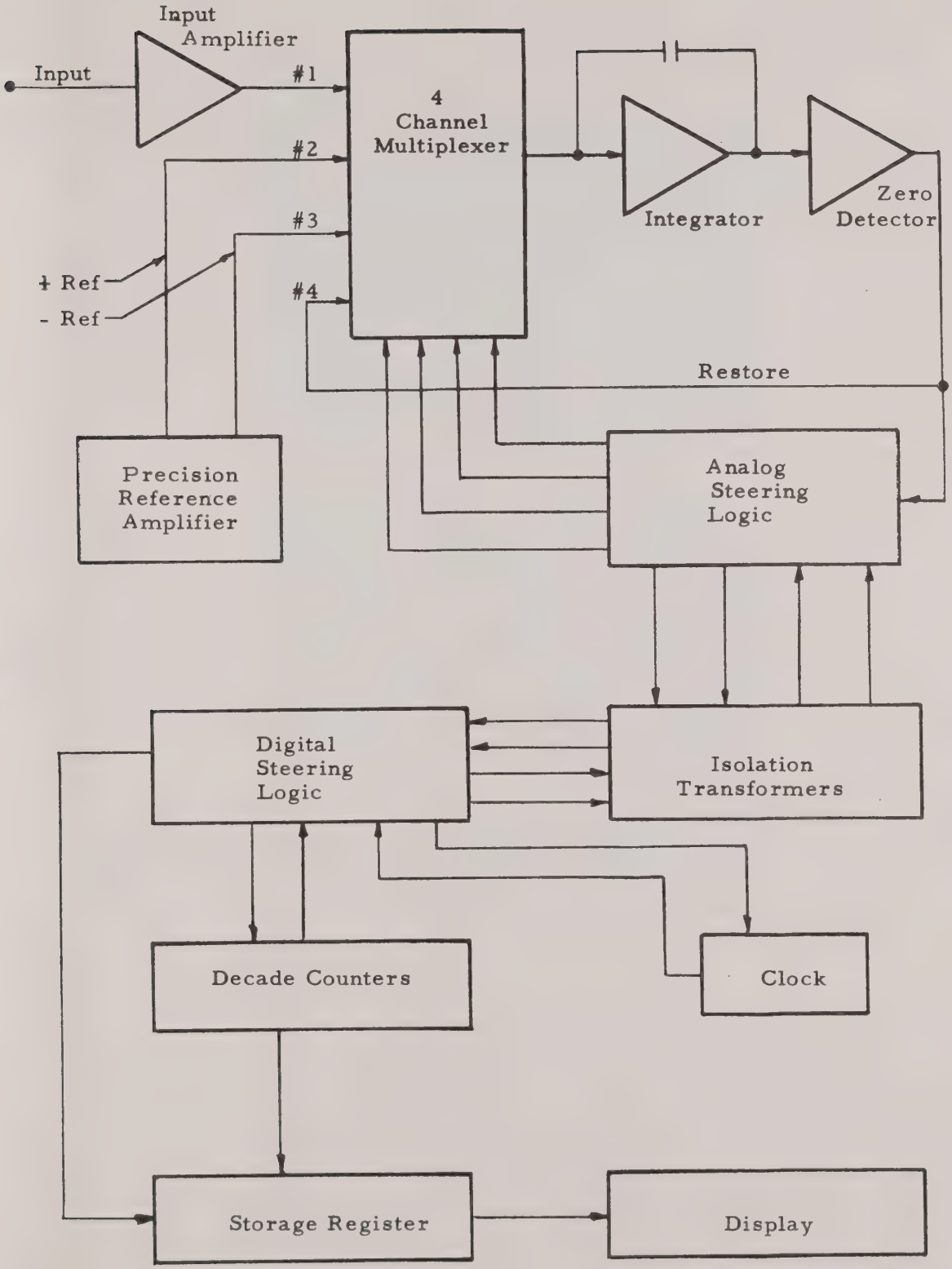


FIGURE 4-1
Functional Block Diagram For Model 8440 Digital Panel Meter

3.5.2 READ AND HOLD

The CALICO Model 8440 Digital Panel Meter comes from the factory with a jumper between the TIME BASE OUTPUT and the ENCODE INPUT. The TIME BASE OUTPUT produces 3 pulses per second. This causes the instrument to encode at a rate of 3 conversions per second. To change this conversion rate, remove the jumper that connects the TIME BASE OUTPUT to the ENCODE INPUT. This jumper is located on the 8440-700 printed circuit board. It is physically located near and electrically connected to pins 3 and 4 on the card edge connector. After removing this jumper a positive going pulse applied to pin 3 will cause the instrument to encode, display the new reading and hold. The pulse applied to pin 3 must be at least 2.4 volts in amplitude and have a rise time of no less than 1 volt per microsecond. The pulse width must be a minimum of 50 microseconds.

NOTE

Any additional positive going pulses that occur on the ENCODE INPUT during the encode cycle will cause an erroneous reading.

The encode time will vary as a function of the reading. The minimum encode time is 100 milliseconds and the maximum time is 250 milliseconds. In addition to the encode time a minimum of 25 milliseconds must be added to allow the analog to digital converter to make any zero adjustments that are necessary. Therefore, the time between conversions must be at least 275 milliseconds for a full scale reading of 15000.

3.5.3 PRINT OUTPUT

The print output level goes to the "0" state approximately 35 nanoseconds after the receipt of an encode input pulse. The print output level will remain in the "0" state until the conclusion of the encode cycle, at which time it returns to the "1" state.

THEORY OF OPERATION

4.1 GENERAL

The CALICO Model 8440 Digital Panel Meter uses a three step integration process for converting an analog input into a digital display. A block diagram which illustrates the theory of operation, is shown in Figure 4-1. Step number one in the process is the restore mode. In this step the output of the zero detector is connected to the input of the integrator through channel #4 of the multiplexer. This removes any zero errors that may exist in the integrator or zero detector. The second step is the integration of the unknown input voltage. At the beginning of the second step, the decade counters are reset to all zeros and the unknown input is connected to the integrator through channel #1 of the multiplexer. At the same time the clock is fed into the decade counter. The system will remain in this state until the decade counters have counted through 9999 and back to 0000. Since the clock is 100 KHz, this process requires 100 milliseconds. At this point the decade counters produce a pulse which is fed through the isolation transformers and into the analog steering logic. This advances the system to the third step. As the system is advanced to the third step the analog steering logic connects one of the two precision reference supplies to the input of the integrator through the multiplexer. The precision reference supply that is selected is of the opposite polarity to the unknown input. The system remains in the third step until the integrator output returns to zero. As the output of the integrator passes through zero, the zero detector feeds an output into the analog steering logic. This is, in turn, fed through the isolation transformers and into the digital steering logic. At this time the clock is stopped and the number accumulated in the decade counters is transferred into the storage register for display. Also at this point the system is returned to step one.

4.2 DETAILED CIRCUIT DESCRIPTION

4.2.1 INPUT AMPLIFIER

The input amplifier is located on the A4 assembly. The schematic diagram for this circuitry is shown on drawing C8440-073. This amplifier consists of a differential source follower, A4Q1 and an integrated circuit amplifier A4IC2. The potentiometric feedback loop is applied from the output, A4 pin 2, to A4Q1-gate 1 through A4R15, A4R14 and A4R12. A tracking ±6 volt power supply is provided to drive the differential source follower. This supply consists of A4IC1, A4CR1, A4CR2, A4R7 and A4R11. The integrated circuit voltage follower A4IC1 is driven from the gain of one feedback point. Therefore, the output of A4IC1 tracks the input voltage, and in turn A4CR1 and A4CR2 provide +6 and -6 volts DC with respect to the input voltage. The input voltage A4 pin 6 is applied to A4Q1-gate 2 through the input attenuator A4R1 and A4R2. This attenuator has an attenuation of

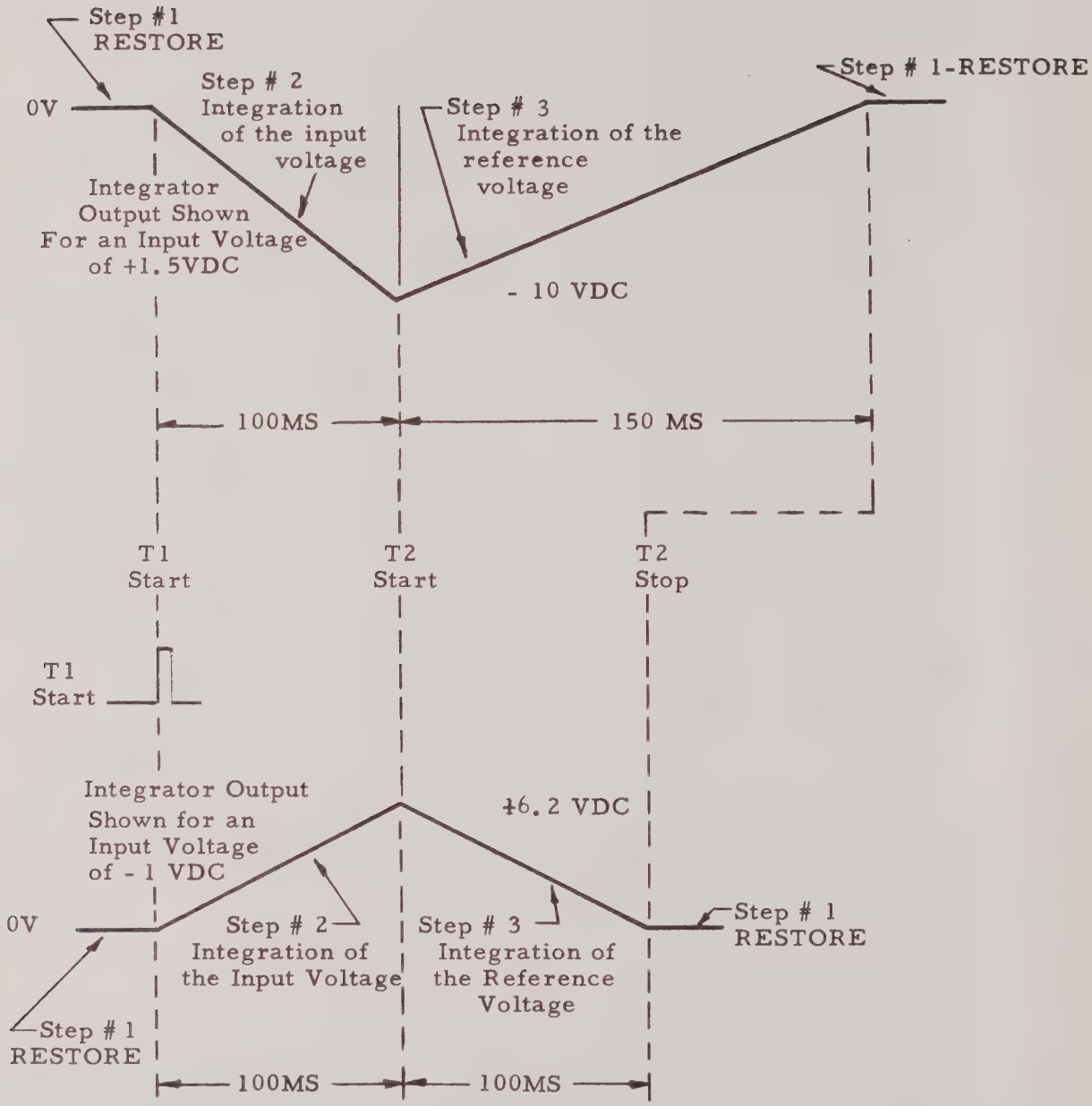


Figure 4-2 Timing Diagram for
Model 8440 Digital Panel Meter

1:1, 10:1 or 100:1, depending on the full scale voltage range of the instrument.

4.2.2 PRECISION REFERENCE AMPLIFIER

The precision reference amplifier is located on the A2 assembly. A schematic diagram is contained in drawing E8440-071. The precision reference amplifier consists of two operational, integrated circuit amplifiers A2IC2 and A2IC4. The first amplifier, A2IC2, has a temperature compensated zener diode in its negative feedback loop, A2CR1. This produces an output at the cathode of A2CR1, of +6.2 volts DC. This output is applied to the second amplifier A2IC4 which is operated at a gain of -1.0. This produces an output of -6.2 volts DC at the anode of A2CR2. This output is applied through A2R5 to the summing junction of the first amplifier. Since the gain of the second amplifier is -1.0, the current that flows through A2CR1 is the zener voltage of A2CR1 divided by the resistance of A2R5. The amplifiers A2IC2 and A2IC4 are unable to provide this amount of current. Therefore, the majority of this current is supplied through A2R9 and A2R24 from the +15 volt and -15 volt DC supplies. The + and - reference outputs are used to drive two of the four inputs of the multiplexer.

4.2.3 4 CHANNEL MULTIPLEXER

The 4 channel multiplexer is located on the A2 assembly. A schematic diagram is shown on drawing E8440-071. The purpose of the 4 channel multiplexer is to connect one of the four input lines to the input of the integrator. Since all four channels are the same, only channel number one, the signal input line will be explained. This channel consists of A2Q5, A2CR5, A2IC7 and A2R27. With a "0" input applied to pin 3 of the level shift amplifier, A2IC7, the output of this amplifier, A2IC7, pin 6, will be -15 volts DC. This forward biases A2CR5 thus pulling the gate of A2Q5 negative. Since A2Q5 is an N channel field effect transistor switch, this negative gate bias causes it to turn off. The off resistance of A2Q5 is approximately 50 megohms. The application of a "1" input to pin 3 of the level shift amplifier, A2IC7, causes the output of this amplifier, A2IC7 pin 6 to be +15 volts DC. This reverse biases A2CR5. In this mode, the gate of A2Q5 is connected to the source of A2Q5 through A2R27. This causes A2Q5 to turn ON. The on resistance of A2Q5 is approximately 50Ω.

4.2.4 INTEGRATOR

The integrator is located on the A2 assembly. A schematic diagram is shown on drawing E8440-071. The integrator is an operational amplifier with capacitive feedback which produces an output voltage with a slope proportional to the input current. The integrator consists of a differential amplifier, A2Q1 and A2IC1,

input resistor A2R17, and feedback capacitor A2C5. The input is applied from the multiplexer output through A2R17 to the inverting input of the operational amplifier.

4.2.5 ZERO DETECTOR

The zero detector is contained on the A2 assembly. A schematic diagram is shown on drawing E8440-071. The purpose of the zero detector is to sense when the output of the integrator passes through zero. It consists of A2IC3, A2R15 and A2R13. The input is applied to pin 3 of A2IC3. The potentiometric feedback is taken from the output, A2IC3 pin 6, through the divider formed by A2R15 and A2R13 back to the inverting input, A2IC3 pin 2. This provides a closed loop voltage gain of 200.

4.2.6 LOGIC

The logic is divided into two sections. The first section is contained on the A2 assembly. The schematic diagram is shown on drawing E8440-071. The second section is contained on the A1 assembly. The schematic diagram is shown on drawing E8440-070. The logic explanation will follow the chronological order of the encode cycle. For this explanation it is assumed that the analog input voltage is + full scale. It is further assumed that the instrument is in its restore state between conversions.

The encode cycle is started by the time base generator, A1Q2. The time base generator is a unijunction oscillator that operates at a rate of 3 pulses per second. This output A1 pin 4 is fed into the encode input A1 pin 3. This drives A1Q3 which is connected as a differentiator. The positive going edge of the time base pulse drives A1Q3 to the "0" state for 10 microseconds. This output is fed into A1IC17 pins 1 and 2. The output of this NAND gate A1IC17 pin 3 produces a T1-START pulse.

The T1-START pulse is used to reset the decade counters, A1IC10 through A1IC14. It also sets A1IC15 pins 4 and 10 to "0". The negative going slope of this pulse is fed through A2T4 and sets A2IC12 pin 4 and A2IC10 pin 10 to "0". Since A2IC12 pin 4 is in the "0" state and no pulse is present at A2T3 the output at A2IC10 pin 13 goes to the "1" state. This activates channel 1 of the multiplexer and connects the unknown input to the input of the integrator. At this same time the output at A1IC15 pin 1 goes to the "1" state which starts the 100 KHz oscillator. The output of the 100 KHz oscillator, A1IC17 pin 11, is fed into the count input of the decade counters. The instrument will remain in this mode until it receives a T2-START pulse. After the decade counters accumulate a count of 9999 the act of advancing to a count of 0000 activates the T2-START output, A1IC17 pin 6.

The T2-START pulse is fed through A2T3 into A2IC11 pin 13 and A2IC10 pin 11. It is at this instant the instrument deter-

mines the polarity of the unknown input voltage. Since it was previously assumed that the input was + full scale, this will drive A2IC11 pins 3 and 8 to the "1" state. This sets A2IC9 pin 13 to the "1" state and A2IC9 pin 10 to the "0" state. As the T2 start pulse occurs A2IC12 pin 4 goes to the "1" state, this forces A2IC9 pins 1 and 4 to the "0" state, thus inhibiting any change in the polarity data at A2IC9 pins 13 and 10. At this time A2IC10 pins 3, 5, and 10 go to the "0" state. This opens channel 1 of the multiplexer, disconnecting the unknown input voltage from the input of the integrator. Since the polarity data at A2IC10 pin 2 is a "0" this drives A2IC10 pin 1 to a "1" state. This connects the negative reference voltage to the integrator input through channel 3 of the multiplexer.

If the polarity of the analog input voltage is negative, the polarity line at A2IC13 pin 2 will be a "0". This will allow the T2-START pulse to be fed through A2T2 into the polarity display flip-flop, thus producing a negative polarity display. The absence of this pulse produces a positive polarity display.

Since the reference voltage is of the opposite polarity from the unknown input voltage this drives the output of the integrator back toward zero. As the integrator output passes through zero this causes A2IC11, pin 3 and 8 to go to a "0". This, in turn, causes a T2-STOP pulse to be fed through A2T1. This pulse forces A1IC15 pin 1 to the "0" state and thus stops the 100 KHz oscillator. This pulse also drives the LOAD STORAGE input of the storage registers A1IC5 through A1IC9. This transfers the accumulated data from the decade counters into the storage registers for display. At this same time the output of A2IC10 pin 10 goes to the "1" state. This disconnects the reference voltage from the integrator input and returns the instrument to the restore mode. In the restore mode the output of the zero detector is fed back to the input of the integrator through channel 4 of the multiplexer. This is used to cancel the zero drift in the integrator or zero detector. The instrument will remain in the restore mode until it receives a new encode input pulse.

4.2.7 POWER SUPPLY

The power supply circuitry is located on the A3 assembly and a schematic diagram is shown on drawing D8440-072.

The power transformer has a split primary and may be operated from 115 VAC or 230 VAC. (for wiring information see section 2.3)

Secondary S1 provides 180 volts rms AC ±10% at a current of 0.018 amperes rms. This is half wave rectified by A3CR1 for use as the anode supply for the display tubes.

Secondary S2 drives a full wave silicon diode bridge, A3CR2, A3CR3, A3CR8, and A3CR9. The output of this bridge drives two 250 microfarad capacitors and provides a ±25 volts DC ±10% with approximately 1.3 volts peak-to-peak ripple. These voltages are regulated down to ±15 volts DC ±10% with a series type regulator. The +15 volts DC regulator consists of A3Q1, A3CR14, A3R2 and A3R3. The -15 volts DC regulator consists of A3Q2, A3CR15, A3R4 and A3R5.

Secondary S3 drives a full wave silicon diode bridge A3CR4, A3CR5, A3CR10 and A3CR11. The output of this bridge drives a 3000 microfarad capacitor and provides +8 volts DC ±10% with approximately 1.2 volts peak-to-peak ripple. This output drives an integrated circuit voltage regulator A3VR1 which provides an output between +4.75 and +5.25 volts DC.

Secondary S4 is used only on models of the 8440 which contain, OPTION G, isolated grounds. Its operation and voltage levels are the same as those listed for secondary number three.

5.1 CALIBRATION PROCEDURE

The following calibration procedure may be performed on a routine basis to insure that the unit remains within the specified tolerances. This procedure should always be performed after any repairs are made on the basic accuracy determining circuitry. Before calibrating the unit, apply AC power and allow a minimum of one hour to permit the internal circuitry to stabilize.

This procedure covers the following adjustments:

1) Zero Adjustment
2) - Full Scale Adjustment
3) + Full Scale Adjustment

NOTE

Since all of the calibration adjustments are accessible from the front panel, the unit need not be removed from its installation for calibration.

The following test equipment is required to perform the calibration procedure:

1. Precision DC voltage standard; COHU 351 or the equivalent.

The calibration procedure should be performed as follows:

1. Remove the range identification tag on the front panel.
2. Short the input leads together and adjust the front panel zero control for all zeros in the display.
3. Apply a precision -DC voltage near full scale and adjust the calibration with the front panel -CAL control until the digital panel meter reads the exact voltage from the DC standard.
4. Apply the same voltage in the positive polarity and adjust the front panel +CAL control until the digital panel meter reads the exact voltage from the DC standard.

5.2 TEST PROCEDURE

The following test procedure, or any part of it, may be performed as required. This procedure should only be performed after completing 5.1 CALIBRATION PROCEDURE. This test procedure covers the following specifications for the digital panel meter:

1. Common Mode Rejection
2. Input Impedance

3. Temperature Coefficient
4. Stability
5. Resolution
6. Input Overload
7. Line Voltage Range
8. Normal Mode Rejection
9. Reading Rate

The following test equipment is required to perform this test procedure:

1. Precision DC voltage standard, COHU Model 351 or equivalent.
2. Oscilloscope, Tektronix Model 531 or equivalent.
3. Oscilloscope Preamplifier, Tektronix Model L or equivalent.
4. Sine wave oscillator, H. P. 200 CD or equivalent.
5. AC wattmeter/voltmeter, Triplett Model 661 or equivalent.
6. Variac, Superior Electric Model 216 or equivalent.
7. Precision Resistor, 1.0 Megohm 0.1 per cent.

5.2.1 AC COMMON MODE REJECTION

Short panel meter input leads together and connect to the high output of the oscillator as shown in Figure 5-1.

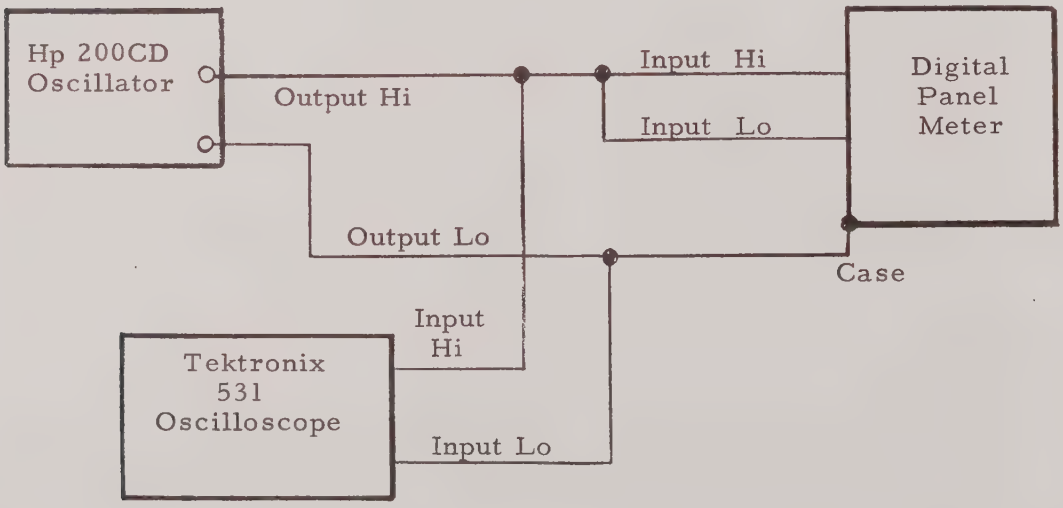


FIGURE 5-1

Connect the low output of the oscillator to the panel meter case and connect the oscilloscope across the oscillator output. Adjust the oscillator to obtain a 2 volts peak-to-peak output at 60 Hz. The digital panel meter must display ±1 digit or less.

5.2.2 DC COMMON MODE REJECTION

Short the panel meter input leads together and connect to the high output of a DC voltage source. Connect the low output of the voltage source to the case of the panel meter as shown in Figure 5-2.

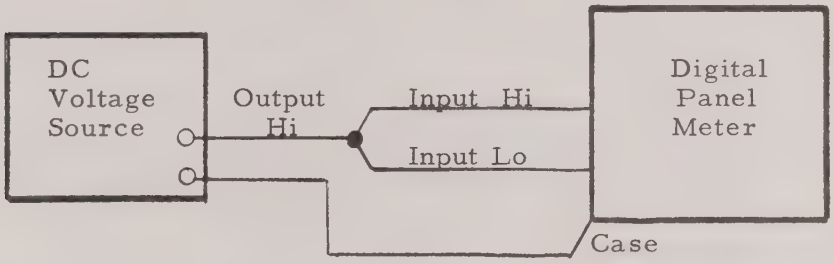


FIGURE 5-2

Adjust the DC output voltage to 1.00 VDC and check that the display indicates ±1 digit or less.

5.2.3 INPUT IMPEDANCE

Using the specification sheet, in the front of this manual, determine the input impedance of the panel meter.

Connect a .1% 1.0 megohm resistor in series with the input high lead of the panel meter. Connect the panel meter input low lead to the output low lead of a precision DC voltage source. Connect the 1.0 megohm resistor to the high output of the DC voltage source as shown in Figure 5-3. Set the voltage source to the full scale input of the Model 8440 Digital Panel Meter.

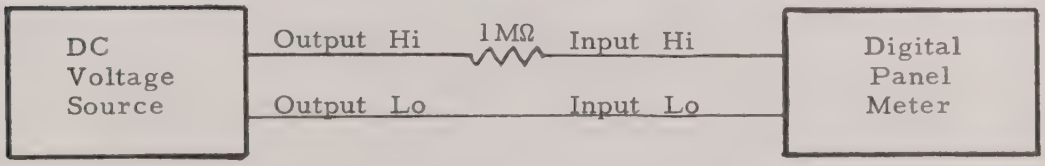


FIGURE 5-3

If the specified input impedance is 10 megohms, the reading should be 91% of full scale ±2%. If the specified input impedance is 10000 megohms, the reading should be 99.99% of full scale, ±.10%.

5.2.4 TEMPERATURE COEFFICIENT (0° C to 55°C)

Allow the machine to warm-up for one hour at room temperature, 25°C and check the full scale calibration as given in the calibration adjustment procedure. Place the unit in an environmental chamber and raise the temperature to 55°C. Allow the unit at least one hour to stabilize at 55°C and then check the calibration. The allowable full scale excursion is ±9 digits at full scale.

5.2.5 TIME STABILITY

Allow the panel meter to stabilize at 25°C for two hours. Connect the input to a precision full scale DC voltage source. Monitor the digital panel meter display for a 24 hour period at 25°C. The allowable excursion is ±1 digit.

5.2.6 RESOLUTION

Connect the panel meter input to a precision DC voltage source. Apply an input of 10% of full scale. Vary this input by precisely the voltage represented by one digit. The display should read this one digit change.

5.2.7 INPUT OVERLOAD

Apply a full scale input voltage and record the reading. Apply an input of 100 times full scale, not to exceed 500 volts DC, for 10 seconds. Return the input to the original full scale voltage. The unit should return to the original reading ±1 digit, within 30 seconds.

5.2.8 LINE VOLTAGE RANGE

The following line voltage tests are made around 115 volts AC 60 Hz. If the unit is used on 230 volts AC or other than 60 Hz, the test should be run at that voltage or frequency.

Connect the variac to the 115 volts AC 60 Hz line. Connect the wattmeter/voltmeter to the output of the variac and connect the panel meter to the wattmeter/voltmeter output. Apply a full scale input signal to the digital panel meter. Vary the line voltage from 105 to 125 volts AC and check that the total variation is two digits or less.

5.2.9 NORMAL MODE REJECTION

Connect the input of the panel meter to the output of a sine wave oscillator. Also connect the input of the oscilloscope to the oscillator output. Set the oscillator to 60 Hz ±0.1 per cent

and increase the output until the least significant digit indicates alternately zeros and ones. Measure the peak output of the oscillator on the oscilloscope. Divide the sensitivity of the least significant digit into the peak sine wave input. This gives the rejection at 60 Hz expressed as a voltage ratio. This voltage ratio should be greater than 100 to 1 or 40 db, and may run as high as 1000 to 1 or 60 db.

5.2.10 READING RATE

Connect the oscilloscope to Pin 3 of the BCD output connector. Check that the pulses occur at 330 millisecond intervals, ±20 per cent.

6.1 GENERAL MAINTENANCE

The CALICO Digital Panel Meter is a solid state instrument designed to give years of trouble free service. Since the instrument has no moving parts maintenance is limited to periodic cleaning in accordance with good commercial shop practices.

6.2 TROUBLESHOOTING

Experience has shown that often the difficulties encountered with equipment are poor input signals or misinterpretation of specifications. Check to be sure that the input is not noisy or erratic, and that you fully understand the characteristics of this instrument as defined in the specifications.

Only skilled personnel who have studied the theory of operation section of this manual should attempt to repair the instrument.

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections.

6.2.1 DISASSEMBLY PROCEDURE

Avoid unnecessary disassembly of the CALICO Digital Panel Meter. Repeated disassembly of this instrument may reduce the mechanical reliability. With the unit removed from its mounting, place the unit on a clean non conductive work surface.

A. Remove the two #4-40 flathead screws from the sides of the meter near the rear.

B. Slide the instrument out of its metal chassis.

C. Place the instrument up side down with the display facing the operator.

D. Remove the two screws on the A1 board near the card

edge connector. Note what type of screw came from which hole for reassembly.

E. Gently "hinge" the A1 board open to a 90° angle, being careful not to put excessive strain on the spring steel hinge wires.

F. Remove the screw closest to the power transformer on the A2 board.

G. At this point the entire assembly will open in an accordian fashion.

H. Removing the remaining screw on the A2 board will allow the removal of the shield.

NOTE

The instrument will normally exhibit a one to two digit noise without the A2 shield.

CAUTION

Excessive strain on the spring steel hinge wires will cause damage to the solder connections at each end of the wire. If this occurs reassemble the instrument and resolder the wires.

6.2.2 LOCALIZING THE MALFUNCTION

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections.

The following power supplies should be checked:

A. +5 volts DC power supply ±.25 VDC (A3VR1 pin 2)

B. +15 volts DC power supply ±10% (emitter A3Q1)

C. -15 volts DC power supply ±10% (emitter A3Q2)

D. 180 VAC half wave rectified supply ±10% (cathode A3CR1)

If the problem is not in the power supplies check the following points as a guide to localizing the problem.

E. Precision Reference Amplifiers

Check that the outputs of the precision reference amplifiers are + and -6.2 volts DC ±5%. The +6.2 volts DC output is located at A2CR1 cathode. The -6.2 volts DC output is located at A2CR2 anode. The ripple level at these outputs should not exceed 3 millivolts peak-to-peak. For additional information pertaining to the operation of this circuit, consult section 4.2.2 of this instruction manual.

F. Input Amplifier

A full scale analog input, 1.5 VDC, 15 VDC or 150 VDC depending on the range of the instrument, should produce an output at A4 pin 2 of 9.3 volts DC ±5%. This output should be of the same polarity as the applied input. For additional information pertaining to the operation of this circuit, consult section 4.2.1 of this instruction manual.

G. Integrator

Check that the integrator output, which is the junction of A2R11 and A2R12, produces a ramping voltage in which the slope is proportional to the input voltage. Check that the integrator output does not clip the waveform at the peaks. For additional information pertaining to the operation of this circuit refer to section 4.2.4 of this instruction manual.

H. Zero Detector

The zero detector output, A2Q2 collector, should change state when the integrator output passes through zero. For additional information pertaining to the operation of this circuit refer to section 4.2.5 of this instruction manual.

CIRCUIT DIAGRAM

7.1 GENERAL

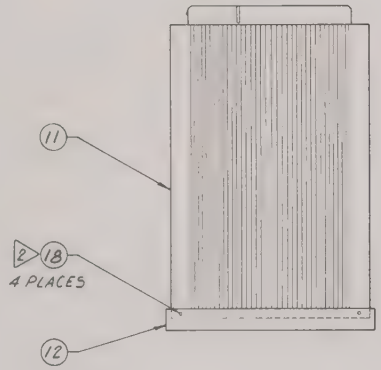
This section contains schematics and mechanical diagrams necessary for operation and maintenance of the Model 8440 Digital Panel Meter. The schematic diagrams illustrate the circuit while the mechanical assemblies indicate the part placement.

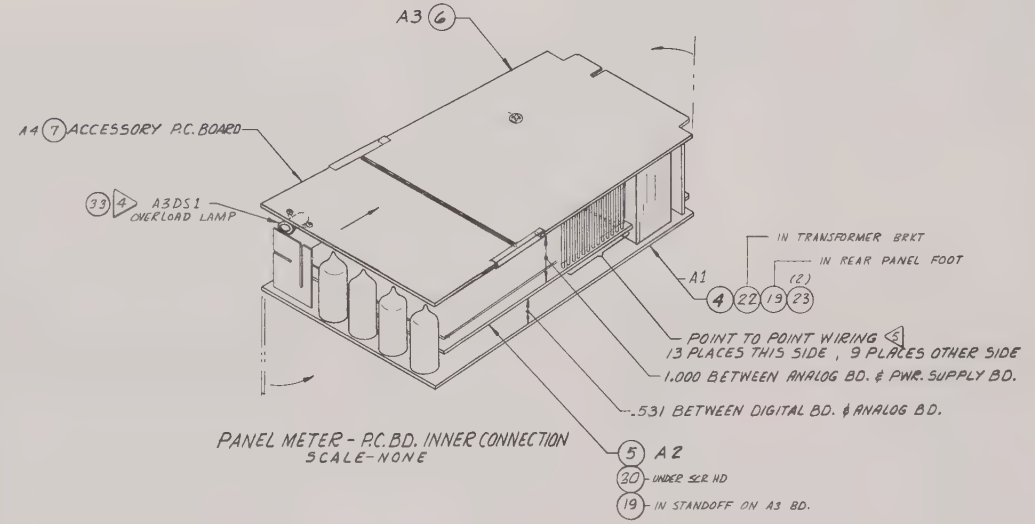
7.2 REFERENCE DESIGNATIONS

Partial reference designators are shown on schematics and mechanical drawings. Prefix these reference designators with assembly and/or sub-assembly designation for the complete reference designator. For example:

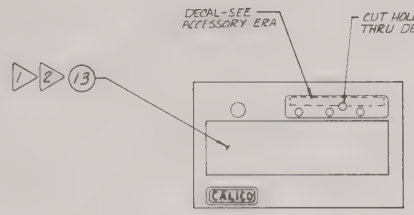
ASSEMBLY/SUB-ASSEMBLY	COMPONENT	COMPLETE DESIGNATION
A1	R1	A1R1
A2	C10	A2C10
A4	IC2	A4IC2

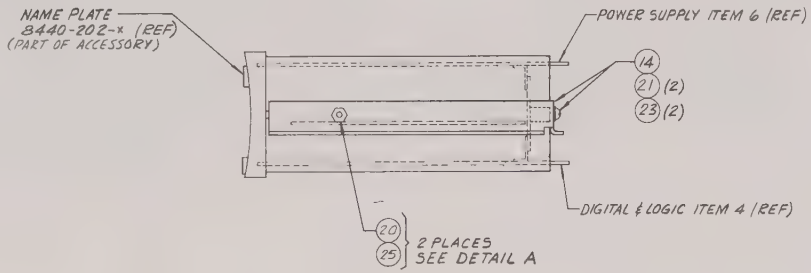
REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

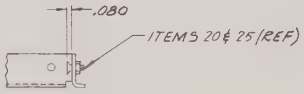



A3 6
A4 7 ACCESSORY P.C. BOARD
3 4 A3DS1 OVERLOAD LAMP
IN TRANSFORMER BRKT
IN REAR PANEL FOOT
A1
4 22 19 (2) 23
POINT TO POINT WIRING 5
13 PLACES THIS SIDE , 9 PLACES OTHER SIDE
1.000 BETWEEN ANALOG BD. & PWR. SUPPLY BD.
.531 BETWEEN DIGITAL BD. & ANALOG BD.
5 A2
20 UNDER SCR HD
19 IN STANDOFF ON A3 BD.

PANEL METER - P.C.BD. INNER CONNECTION
SCALE-NONE







DETAIL A

2 SEE WIRE TAB TABLE A8440-050.

4 MOUNT A3DS1 TO ACCESSORY BD USING #22 AWG BUS WIRE.

3. FOR INNER CONNECTION DIAGRAM SEE DWG. NO. C8440-074

5 INSTALL POLARIZER BETWEEN BEZEL & ENCLOSURE PRIOR TO ROLL PIN INSTALLATION.

1 FRONT SIDE OF POLARIZER IS DETERMINED BY LAYING POLARIZER ON A REFLECTIVE SURFACE. WHEN DARKER IMAGE SHOWS THRU, FRONT SIDE OF POLARIZER IS NEAREST YOU.

NOTES (UNLESS OTHERWISE SPECIFIED)

PL 8440-400 PARTS LIST SHEET 3

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X ± 30' BREAK ALL SHARP CORNERS & EDGES MACH SURFACES

DWG D S.Z6

TITLE PANEL METER ASSEMBLY

CALICO CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA

MODEL 8440

CONTRACT NO

CODE IDENT 16067

RELEASE

CHECKER 11/30/70

DES ENGR PURCHASING

PROJ ENGR

DRFTSMN 7/8/70 CHF ENGR

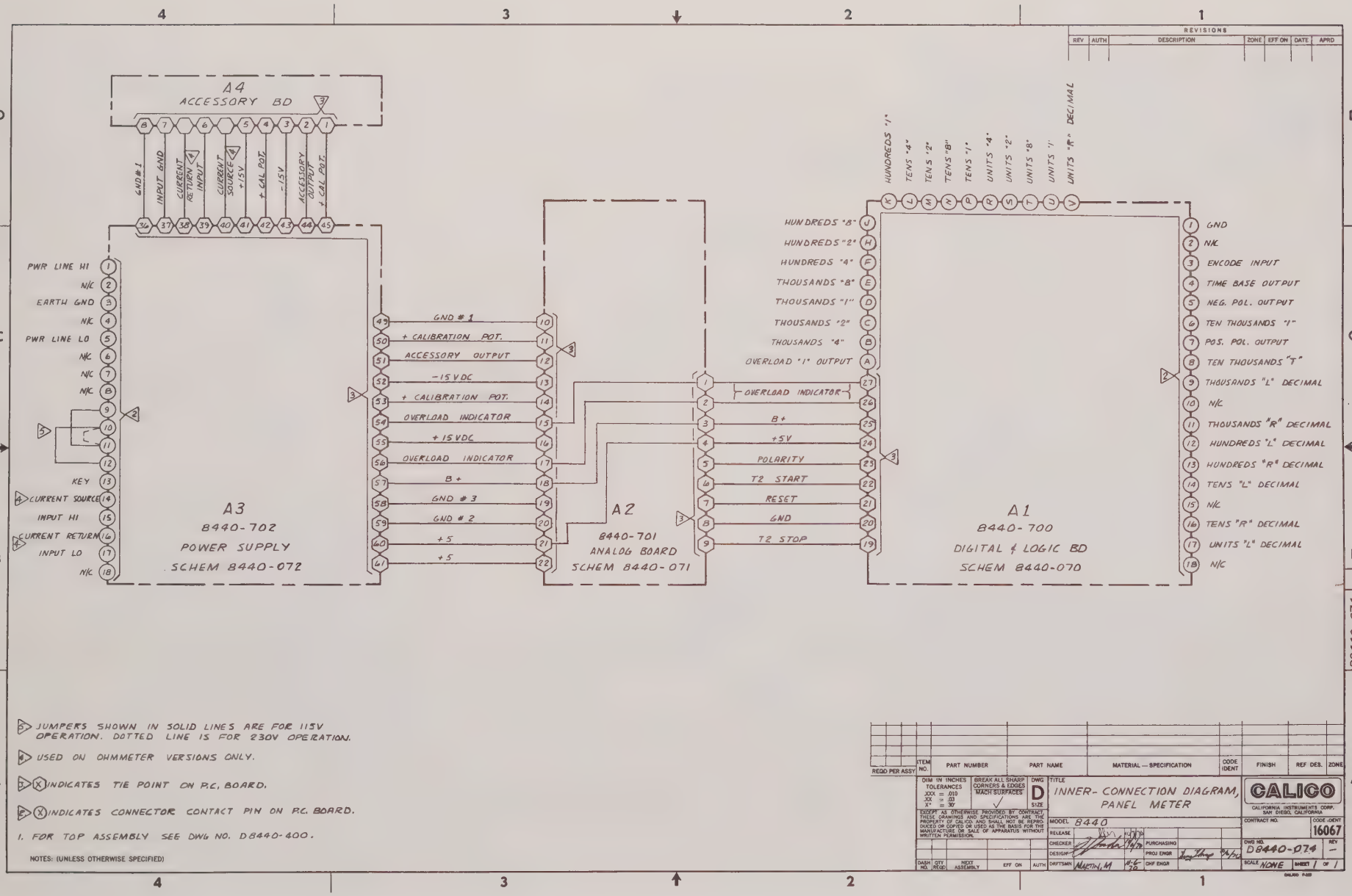
DWG NO. D8440-400 REV A

SCALE 11 (UNLESS NOTED) SHEET 2 OF 3

CALICO P-169

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

D8440-400 A



3 JUMPERS SHOWN IN SOLID LINES ARE FOR 115V OPERATION. DOTTED LINE IS FOR 230V OPERATION.

4 USED ON OHMMETER VERSIONS ONLY.

5 (X) INDICATES TIE POINT ON P.C. BOARD.

6 (X) INDICATES CONNECTOR CONTACT PIN ON P.C. BOARD.

1. FOR TOP ASSEMBLY SEE DWG NO. D8440-400.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS					
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY							

DIM IN INCHES TOLERANCES XXX = .010 XX = .03 X° = 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES
DWG SIZE D

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TITLE: INNER-CONNECTION DIAGRAM, PANEL METER

MODEL 8440

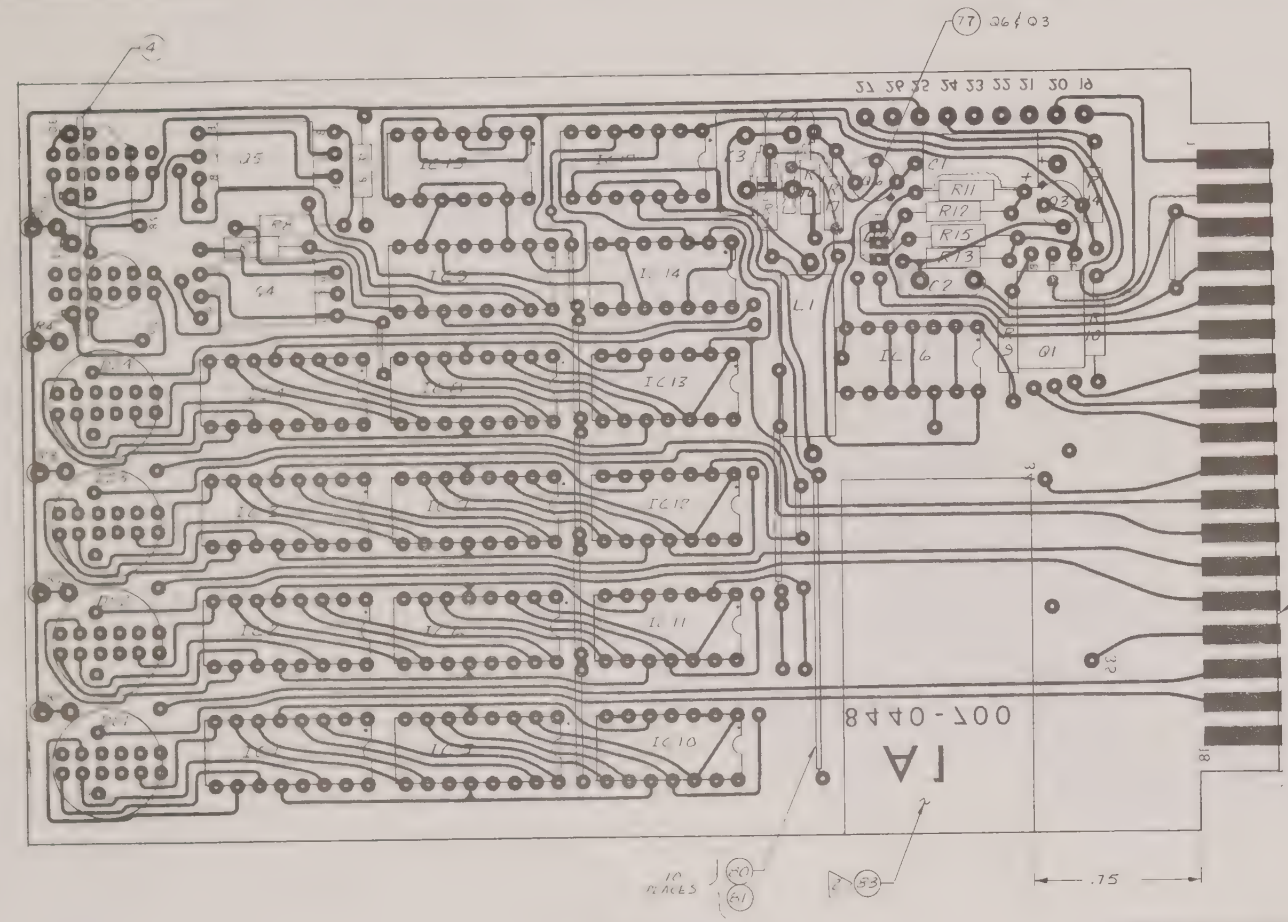
RELEASE			
CHECKER		PURCHASING	
DESIGN		PROJ ENGR	
DRFTSMN	MARTIN, M 11-5-70	CHF ENGR	

CALICO
CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO.
CODE IDENT 16067
DWG NO. D8440-074
REV —
SCALE NONE SHEET 1 OF 1

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

D8440-074



-1 P.C BOARD ASSY

EW COMPONENT SIDE

(TOP CLAD DELETED FOR CLARITY)

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APPD

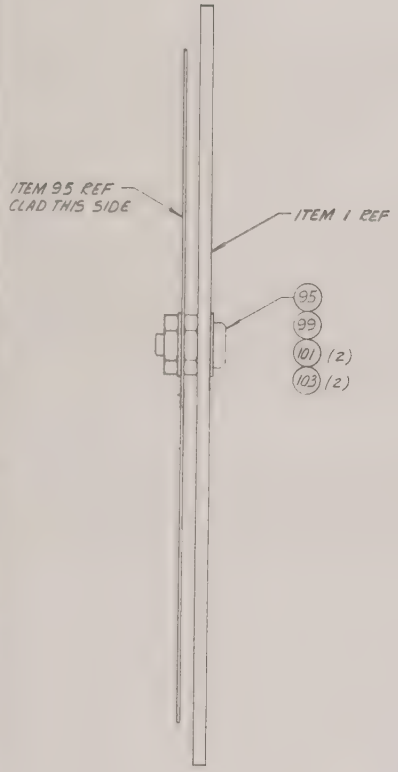
ITEM NO	PART NUMBER	PART NAME	MATERIAL – SPEC FICATION	CODE IDENT	FINISH	REF DES	ZONE
REQD PER ASSY							

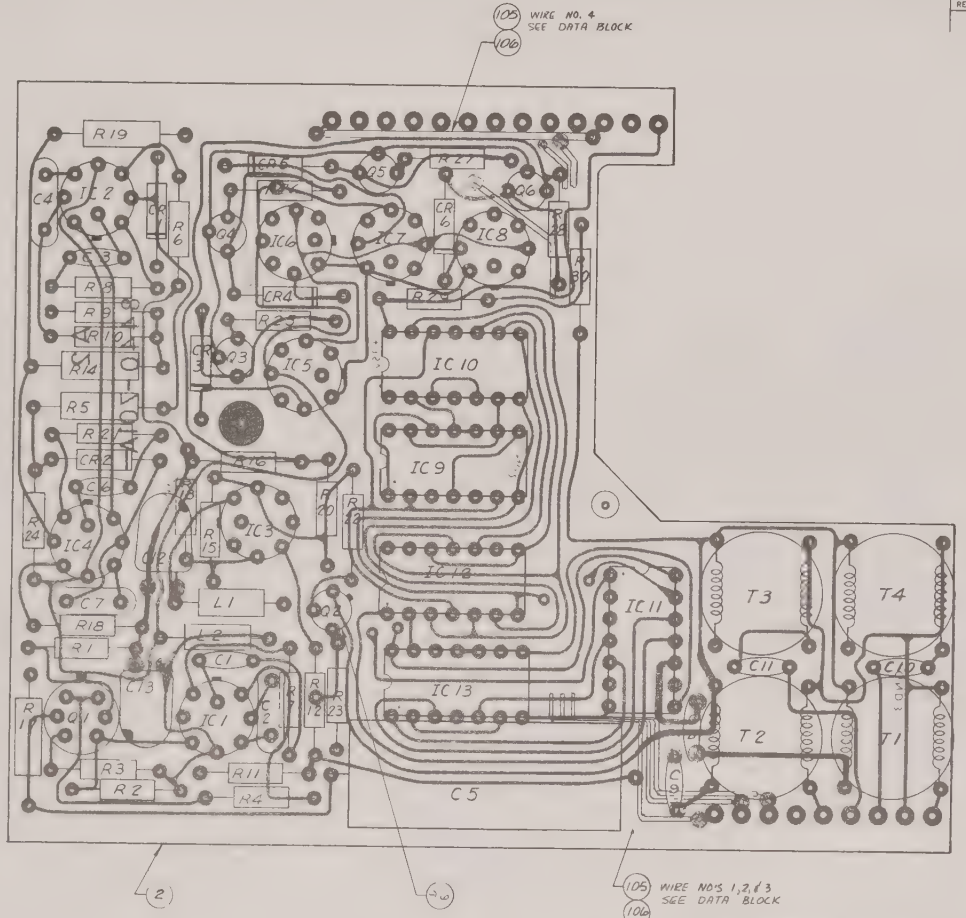
3 B440-700 PARTS LIST SHEETS 4 THRU 6

DIMENSIONS IN INCHES TOLERANCES XXX .010 XX .01 X .1 ANGLES ± 1°	BREAK ALL SHARP CORNERS & EDGES MACH. SURFACES .005
CWG D	SIZE
TITLE	DIGITAL & LOGIC BOARD ASSEMBLY 1:1
MODEL	B440
RELEASE	
CHECKED	PURCHASE NO.
DESIGN	PROJ. ENGR.
DRAFTSMAN	CHIEF ENGR.
CALICO	CONTRACT NO. 16067
DRAWING	DB440-700 REV B
SCALE 1:1	SHEET 2 OF 6

DB440-700B

A





WIRE DATA				
NO.	FROM	TO	AWG	REMARKS
1	A2-1	A2-15	24	BUSS
2	A2-2	A2-17	24	BUSS
3	A2-3	A2-18	24	BUSS
4	A2-10	A2-20	24	BUSS

ALL WIRES TEFLON SLEEVED AND ON TOP SIDE OF BD.

-1 P.C. BOARD ASSY
VIEW COMPONENT SIDE
[TOP CLAD DELETED FOR CLARITY]

1. FOR SCHEMATIC SEE DRAWING No. E8440-071

NOTES (UNLESS OTHERWISE SPECIFIED)

REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APPRO

ITEM NO	PART NUMBER	PART NAME	MATERIAL – SPECIFICATION	CODE IDENT	FINISH	REF DES	ZONE
REQD PER ASSY	PL 8440-701-1	PARTS LIST SHEETS 4 THRU 6					

DIM IN INCHES TOLERANCES XXX = .010, XX = .03, X = .1 — BREAK ALL SHARP CORNERS & EDGES MACH SURFACES — DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

TITLE: ANALOG BOARD ASSEMBLY A2

MODEL: 8440

RELEASE

DRAWN

DESIGN

CHECKED

PROJ. ENGR

SUPV'SN

CHIEF ENGR

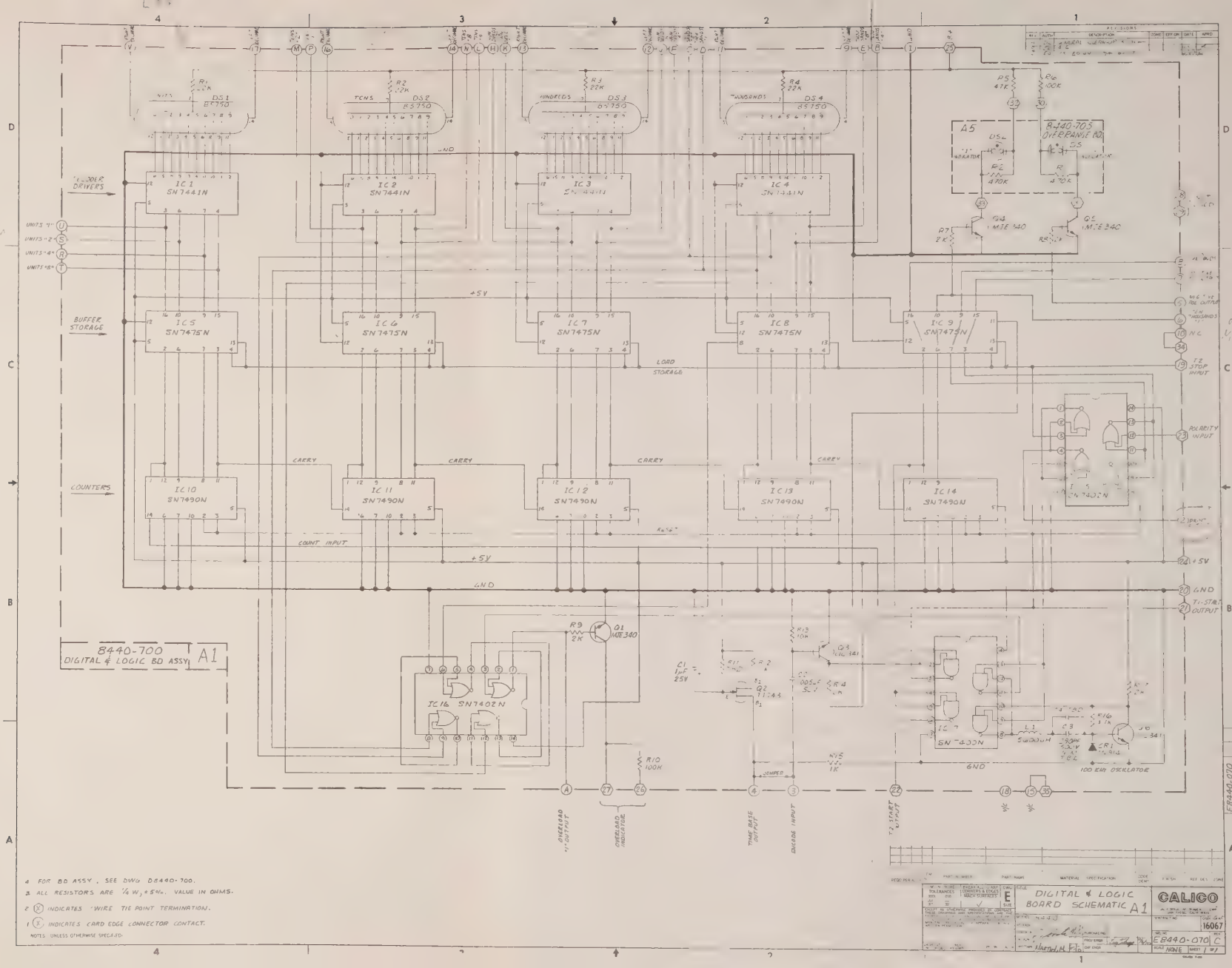
CALICO — CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA

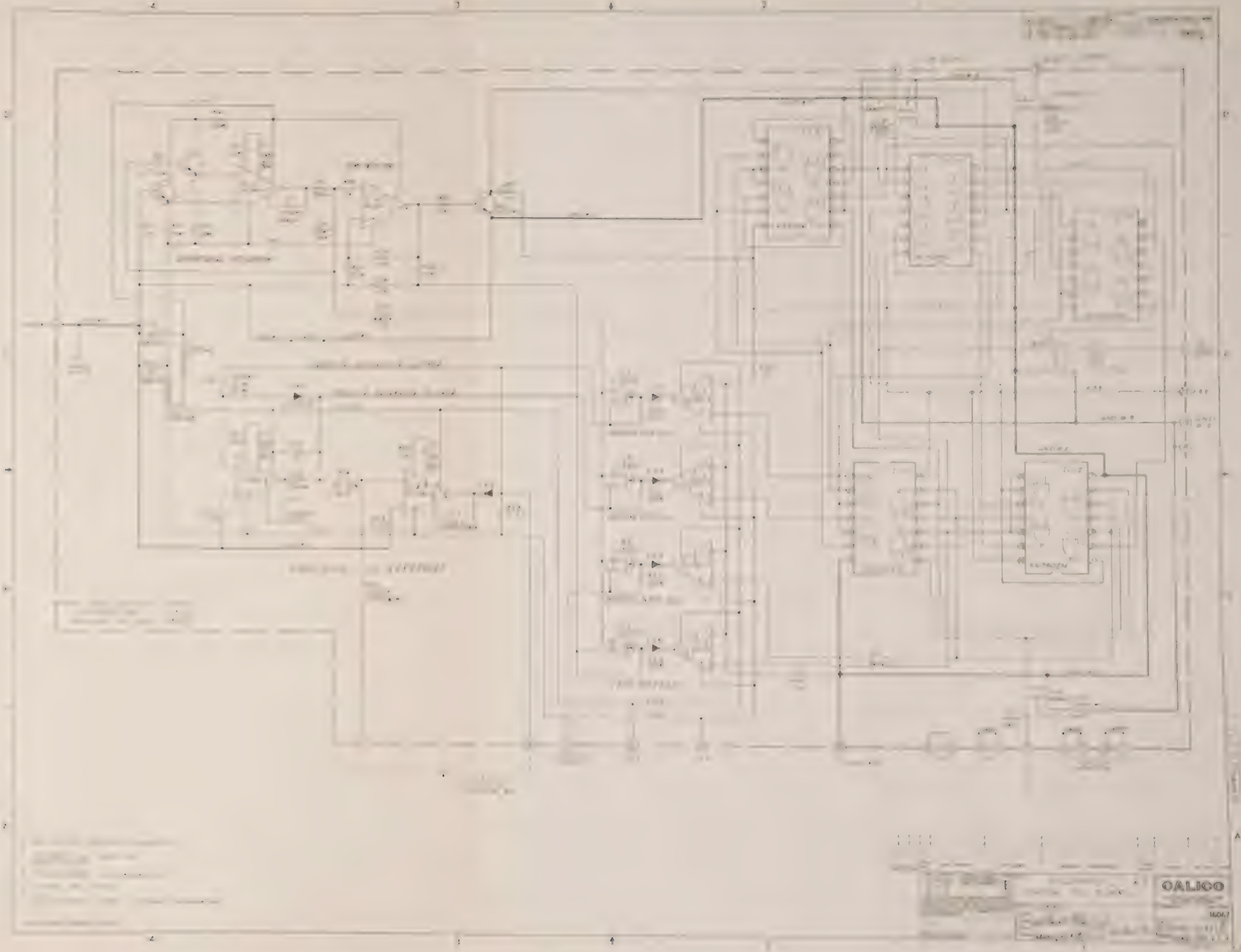
CONTRACT NO — CODE IDENT 16067

DWG NO D8440-701 REV B

SCALE 4/1 SHEET 2 OF 6

D8440-701 B


8440-700
DIGITAL & LOGIC BD ASSY A1
DECODER DRIVERS
BUFFER STORAGE
COUNTERS
LOAD STORAGE
COUNT INPUT
CARRY
+5V
GND
IC1 SN7441N
IC2 SN7441N
IC3 SN7441N
IC4 SN7441N
IC5 SN7475N
IC6 SN7475N
IC7 SN7475N
IC8 SN7475N
IC9 SN7475N
IC10 SN7490N
IC11 SN7490N
IC12 SN7490N
IC13 SN7490N
IC14 SN7490N
IC15 SN7402N
IC16 SN7402N
DS1 DS2 DS3 DS4 DS750
R1 R2 R3 R4 22K
R5 47K
R6 100K
R7 2K
R9 2K
R10 100K
R11 R12 R13 10K
R14 R15 1K
R16 1K
C1 1uF 25V
C2 .005uF
C3 .39pF
L1 5.600uH
Q1 MJE340
Q2 TIP33
Q3 MJE181
Q4 MJE340
Q5 MJE340
Q6 MJE340
A5 8440-705 OVERRANGE BD
UNITS "1"
UNITS "2"
UNITS "4"
UNITS "8"
OVERLOAD OUTPUT
OVERLOAD INDICATOR
TIME BASE OUTPUT
GATE INPUT
T1 START OUTPUT
T2 STOP INPUT
POLARITY INPUT
100 KHz OSCILLATOR
JUMPER
NOTES: UNLESS OTHERWISE SPECIFIED
1 (X) INDICATES CARD EDGE CONNECTOR CONTACT.
2 (X) INDICATES WIRE TIE POINT TERMINATION.
3 ALL RESISTORS ARE 1/4 W, ±5%. VALUE IN OHMS.
4 FOR BD ASSY, SEE DWG E8440-700.
DIGITAL & LOGIC BOARD SCHEMATIC A1
CALICO
16067
E8440-010
C
NONE
E8440-010


CALICO

WIRE TABLE -1

WIRE NO.	FROM	TO	AWG & COLOR
1	VR1-1	A3-35	ITEMS 57 & 58
2	VR1-2	A3-31	
3	E1	A3-32	
4	A3-32	A3-34	ITEM 57
5	A3-30	A3-31	
6	DS1-SHLD	A3-47	EXISTING DS1 WIRES
7	DS1-RED	A3-46	
8	DS1-BLU	A3-48	

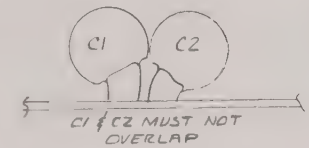
WIRE TABLE -2

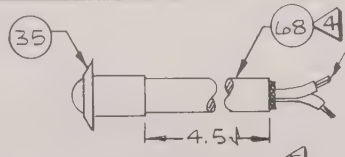
DELETE WIRES 4 & 5 FROM -1 TABLE

1	VR2-1	A3-33	ITEMS 57 & 58
2	VR2-2	A3-30	
3	E2	A3-34	

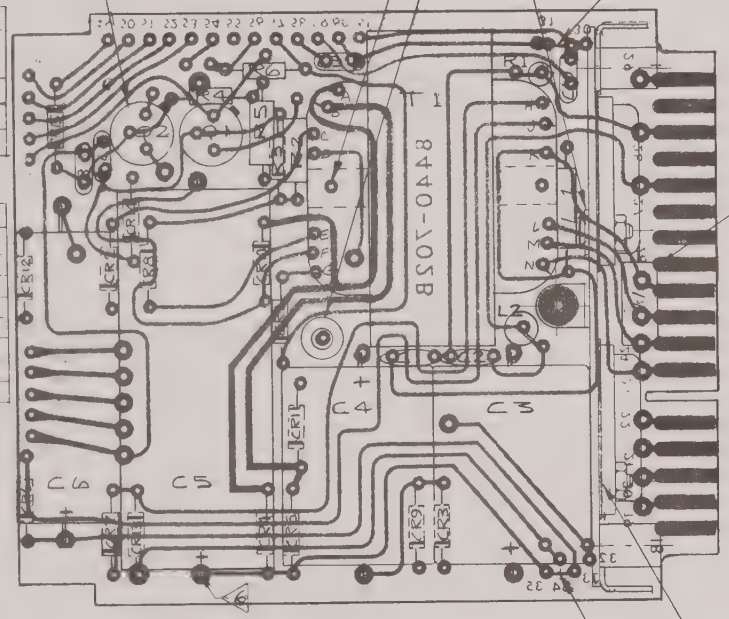
TRANSFORMER WIRING

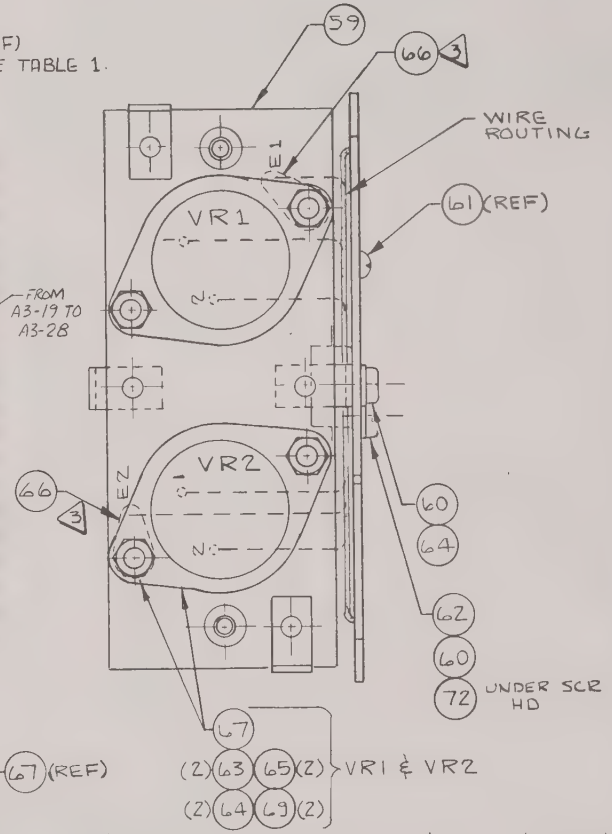
PC BD LTR	TO T1	PC BD LTR	TO T1
A	WHT/BRN	H	WHT/ORN
B	BLK	J	WHT/RED
C	WHT	K	YEL
D	GRY	L	ORN
E	VIO	M	RED
F	BLU	N	BRN
G	GRN		





DS1 ASSY (5)





(4) -2 P.C. BOARD ASSY

VIEW COMPONENT SIDE [TOP CLAD DELETED FOR CLARITY]

(6) SLEEVE LEADS OF C3, C4, & C5

(6) A3DS1 IS PHYSICALLY MOUNTED ON ACCESSORY BOARD. SEE D8440-400 FOR LOCATION.

(6) MODIFY ITEM 68 [RG-174/U] BY REMOVING CENTER CONDUCTOR, AND THEN RUNNING DS1 LEADS THRU SHIELDED CABLE.

(3) INSTALL ITEM 66 BETWEEN SCREW HEAD AND SHOULDER WASHER.

(2) COMPONENT ASSY SEQUENCE:
A. INSTALL T1
B. INSTALL SMALL COMPONENTS.
C. INSTALL C3, C4, C5, & C6.

1 FOR SCHEMATIC DIAGRAM, SEE DWG D8440-072.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
1	2	P/L8440-702-2	& -1 PARTS LIST	SHEETS 4 & 5				
1	1	P/L8440-702-1	PARTS LIST	SHEETS 4 & 5				

DIM IN INCHES
TOLERANCES
XXX = .010
XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE: BOARD, PRINTED CIRCUIT, POWER SUPPLY, A3

MODEL 8440

RELEASE			
CHECKER		PURCHASING	
DESIGN		PROJ ENGR	
DRFTSMN	MARTIN, M 2-18-70	CHF ENGR	

DASH NO. | QTY REQD. | NEXT ASSEMBLY | EFF ON | AUTH

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

DWG NO. C8440-702

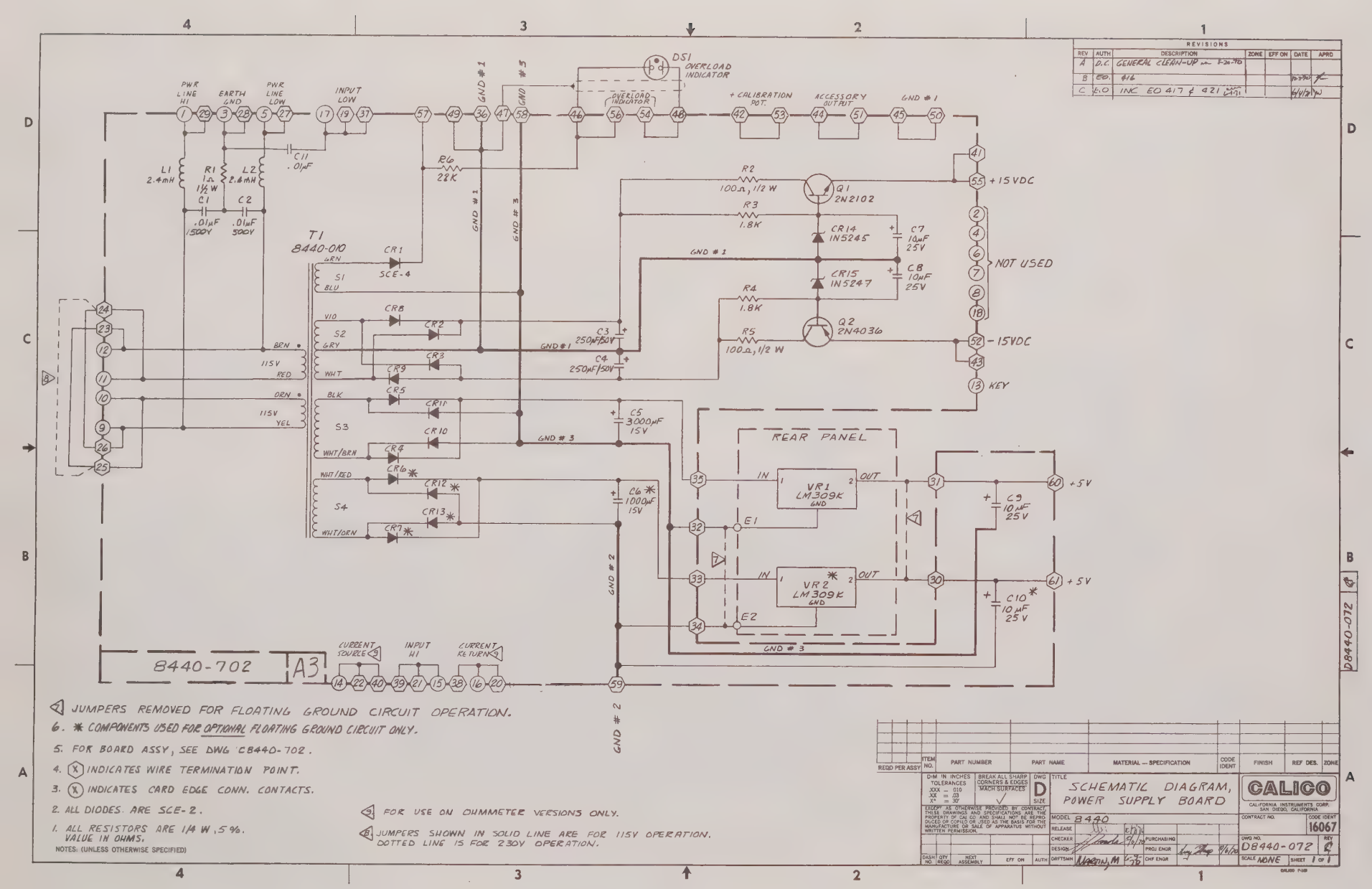
REV C

SCALE 2:1

SHEET 2 OF 5

C8440-702 C

CALICO F-102



◁ JUMPERS REMOVED FOR FLOATING GROUND CIRCUIT OPERATION.

6. * COMPONENTS USED FOR OPTIONAL FLOATING GROUND CIRCUIT ONLY.

5. FOR BOARD ASSY, SEE DWG C8440-702.

4. (X) INDICATES WIRE TERMINATION POINT.

3. (X) INDICATES CARD EDGE CONN. CONTACTS.

2. ALL DIODES ARE SCE-2.

1. ALL RESISTORS ARE 1/4 W, 5%. VALUE IN OHMS.

NOTES: (UNLESS OTHERWISE SPECIFIED)

◁ FOR USE ON OHMMETER VERSIONS ONLY.

◁ JUMPERS SHOWN IN SOLID LINE ARE FOR 115V OPERATION. DOTTED LINE IS FOR 230V OPERATION.

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

REQD PER ASSY

DIM IN INCHES TOLERANCES .XXX ± .010 .XX ± .03 X° ± .10'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES
DWG SIZE D

TITLE: SCHEMATIC DIAGRAM, POWER SUPPLY BOARD

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

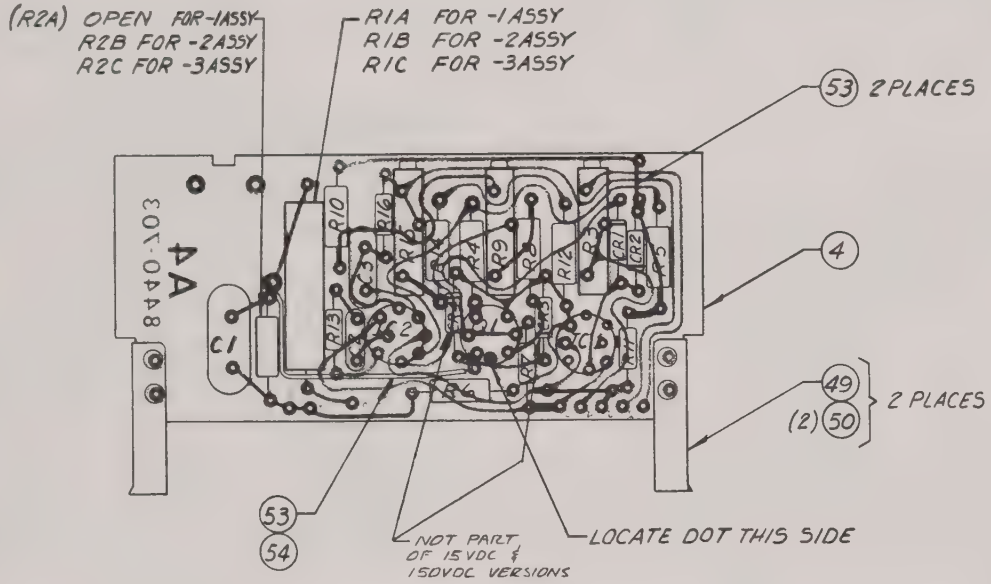
MODEL 8440
CONTRACT NO.
CODE IDENT 16067
DWG NO. D8440-072 REV C
SCALE NONE SHEET 1 OF 1

RELEASE
CHECKER
DESIGN
DRFTSMN
PURCHASING
PROJ ENGR
CHF ENGR

DASH NO. | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CAL CO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



-2 P.C. BD. ASSY SHOWN (VIEW COMP. SIDE)
-1 & -3 ASSY SAME AS -2 EXCEPT AS NOTED ABOVE

C8440-703 A

PL 8440-703 PARTS LIST SHEET 4 & 5

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES TOLERANCES .XXX ± .010 .XX ± .03 X° ± 30' | BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓ | DWG C SIZE

TITLE: PREAMPLIFIER BOARD ASSEMBLY

MODEL 8440

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO. | CODE IDENT 16067

DWG NO. C8440-703 | REV A

SCALE 2:1 | SHEET 2 OF 5

RELEASE | CHECKER | DESIGN | DRFTSMN 10/7/70 | PURCHASING | PROJ ENGR | CHF ENGR

DASH NO | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

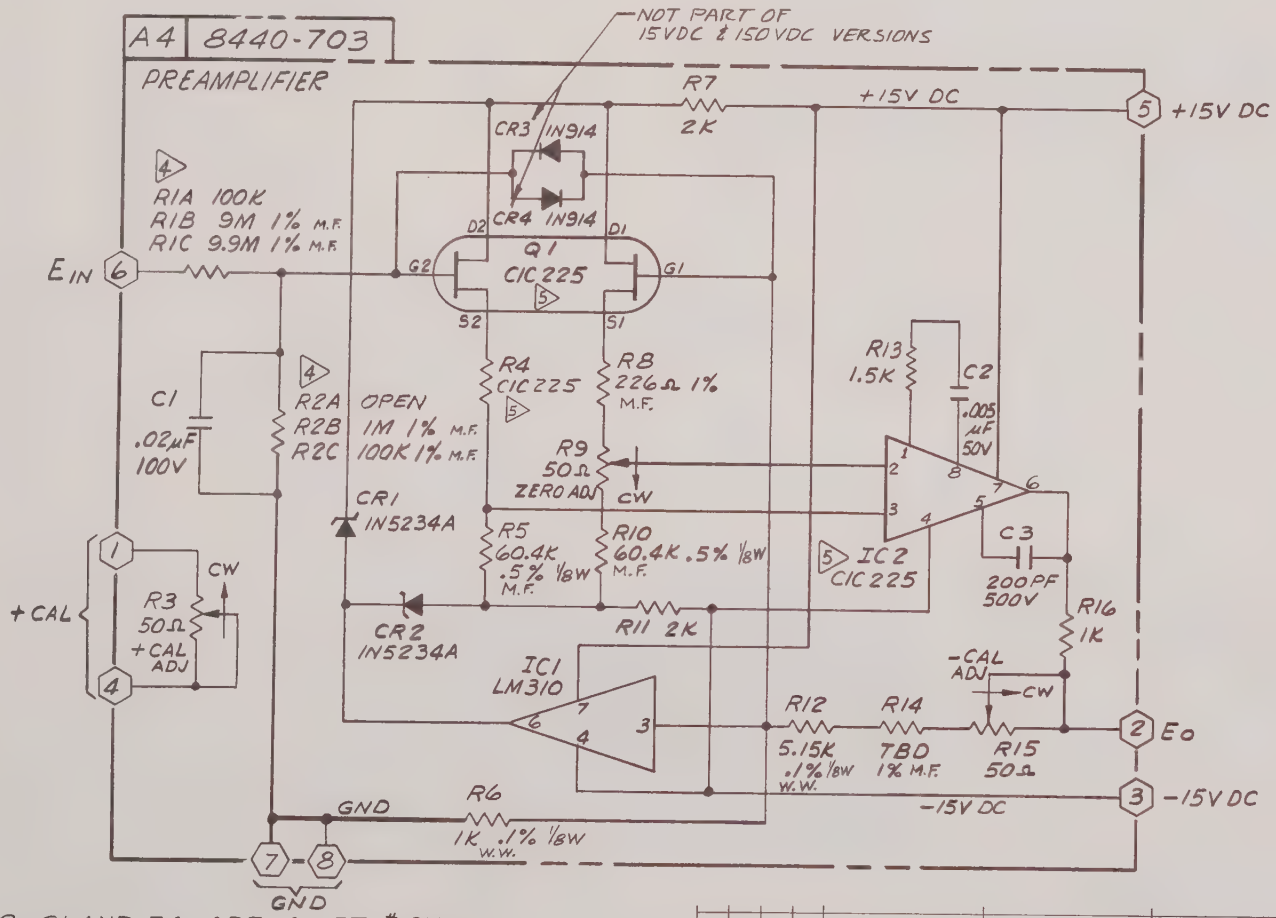
2. FOR WTT SEE A8440-051

1. FOR SCHEMATIC SEE DWG. No. C8440-073

NOTES: (UNLESS OTHERWISE SPECIFIED)

CALICO F-122

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD
A	E.O	416			12-3-70	



5 IC2, Q1, AND R4 ARE A SET # CIC 225

4 R1A & R2A ARE USED IN 1.5V DC INSTRUMENTS
R1B & R2B MATCHED SET CIC 504-1 ARE USED IN 15V DC INSTRUMENTS
R1C & R2C MATCHED SET CIC 504-2 ARE USED IN 150V DC INSTRUMENTS

3. (X) INDICATES TIE POINT ON P.C. BOARD

2. FOR BOARD ASSEMBLY SEE DWG. No. C8440-703

1. RESISTORS ARE 1/4W 5% VALUE IN OHMS

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE	REQD PER ASSY

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE: SCHEMATIC DIAGRAM PREAMPLIFIER

MODEL 8440

RELEASE			
CHECKER		PURCHASING	
DESIGN		PROJ ENGR	
DRFTSMN	10/6/70	CHF ENGR	

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

DWG NO. C8440-073 REV A

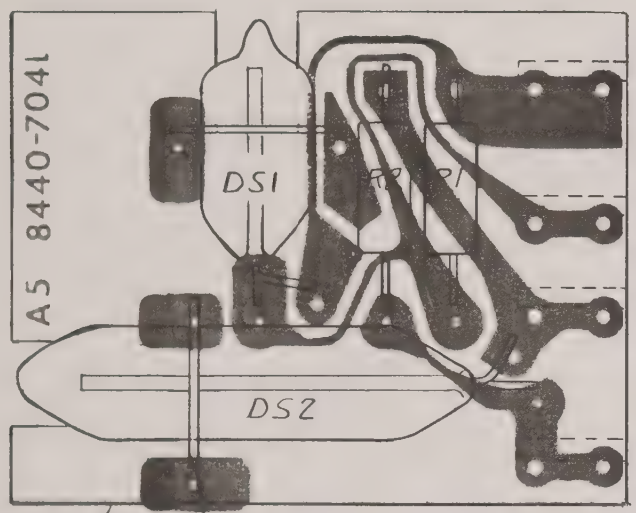
SCALE — SHEET 1 OF 1

C8440-073 A

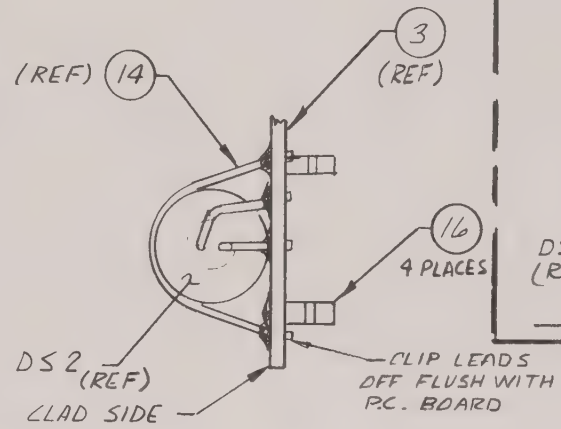
CALICO F-302

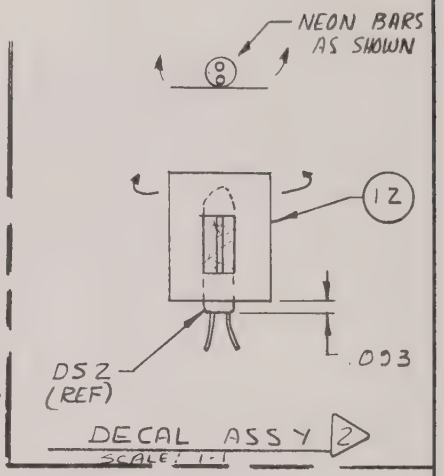
B | B8440-704

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



-1 ASSY
CLAD NEAR SIDE





REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
	1	1	P/L 8440-704	PARTS LIST	SHEET 4.			
-1								

2. INSTALL DECAL ON DS2 PRIOR TO SOLDERING DS2 TO BOARD.
1. FOR SCHEMATIC, SEE DWG NO. E 8440-070.

NOTES: (UNLESS OTHERWISE SPECIFIED)

DIM IN INCHES TOLERANCES	BREAK ALL SHARP CORNERS & EDGES	DWG SIZE
.XXX = .010 .XX = .03 X = 30'	MACH SURFACES ✓	B

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH
-1	1	8440-700		

TITLE: OVER RANGE BD ASSY A5

MODEL 8440

RELEASE			
CHECKER		10/6/70	PURCHASING
DESIGN			PROJ ENGR
DRFTSMN	MARTIN, M	10-6-70	CHF ENGR

CALICO
CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

DWG NO. B8440-704 REV B

SCALE 4X FULL SHEET 2 OF 4

CALICO F-101

REPLACEMENT PARTS

8.1 GENERAL

This section contains ordering information and complete list of replaceable parts. Parts are listed by major assembly in alphanumeric order of their reference designators. Description, manufacturers' part number, manufacturers' code ident number (see Appendix A for list of manufacturers), and CALICO's stock number are indicated.

8.2 ORDERING INFORMATION

In order to provide our customers with prompt service on replacement parts, please provide the following information, when applicable, for each part ordered.

a) Model number and serial number of the instrument

b) CALICO part number of the sub-assembly where component is located

c) Component reference designator

d) Component description

e) Component manufacturer number and code ident

f) CALICO stock number

All replacement parts orders should be placed with CALIFORNIA INSTRUMENTS COMPANY, a division of Aiken Industries, San Diego, California.

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	D8440-400	PANEL METER ASSY	16067		1
					2
					3
A1	D8440-700-1	DIGITAL and LOGIC BD ASSY	16067		4
A2	D8440-701-1	ANALOG BD ASSY	16067		5
A3	D8440-702-1	POWER SUPPLY BD ASSY	16067		6
A4		ACCESSORY ASSY			7
					8
					9
					10
	C8440-204-7	ENCLOSURE	16067	1-10198	11
	C8440-205-7	BEZEL	16067	1-10199	12
	B8440-206-7	POLARIZER	16067	2-10313	13
	C8440-207-7	MOUNTING BRACKET	16067	1-10223	14
	8440-100	DECAL	16067	2-10348	15
					16
					17
	1/16 DIA x 3/16 LG	ROLL PIN, BLK OILED	73734	2-10314	18
	#4-40 UNC x 1/4 LG	SCREW, PAN HD			19
	#4-40UNC x 1/4 LG	SCREW, FLAT HD			20
	#4-40UNC x 1/2 LG	SCREW, PAN HEAD			21
	# 4 x 1/4 LG TYPE B	SCREW, SELF-TAPPING	45722	2-10289	22
	#4	WASHER, INT STAR			23
					24
	#4-40	NUT, HEX			25
					26
					27
	.010 DIA	PIANO WIRE, TIN PLATED			28
					29
	NW4-2812	NYLON WASHER, #4	75987	2-10142	30
					31
					32
	22 GA.	BUSS WIRE			33
					34
					35
					36

MODEL 8440 — CALICO P/N 8440-400 B — ASSY R.O.

TITLE PANEL METER ASSY — SHT 3 OF 3

CALICO — CALIFORNIA INSTRUMENTS CORP., SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1	8440-700-1	DIGITAL and LOGIC ASSY	16067		1
	-7	P.C. BOARD	16067	1-60104	2
					3
A5	B8440-704-1	OVERRANGE BD ASSY	16067		4
					5
A1C1	TE1200	CAPACITOR 1μF 25V	56289	6-10152	6
A1C2	CK502	CAPACITOR .005μF 50V	71590	6-10078	7
A1C3	CM05F391J03	CAPACITOR 390PF 500V	81349	6-10289	8
A1C4	CM05	CAPACITOR T.B.D.	81349		9
					10
A1CR1	IN 914	DIODE	81349	3-10118	11
					12
					13
					14
A1DS1	B5750	NIXIE TUBE	83594	2-30031	15
A1DS2	B5750	NIXIE TUBE	83594	2-30031	16
A1DS3	B5750	NIXIE TUBE	83594	2-30031	17
A1DS4	B5750	NIXIE TUBE	83594	2-30031	18
					19
					20
					21
					22
A1IC1	SN744IN	I.C.	27014	3-60003	23
A1IC2	SN744IN	I.C.	27014	3-60003	24
A1IC3	SN744IN	I.C.	27014	3-60003	25
A1IC4	SN744IN	I.C.	27014	3-60003	26
A1IC5	SN7475N	I.C.	27014	3-60004	27
A1IC6	SN7475N	I.C.	27014	3-60004	28
A1IC7	SN7475N	I.C.	27014	3-60004	29
A1IC8	SN7475N	I.C.	27014	3-60004	30
A1IC9	SN7475N	I.C.	27014	3-60004	31
A1IC10	SN7490N	I.C.	27014	3-60005	32
A1IC11	SN7490N	I.C.	27014	3-60005	33
A1IC12	SN7490N	I.C.	27014	3-60005	34
A1IC13	SN7490N	I.C.	27014	3-60005	35
A1IC14	SN7490N	I.C.	27014	3-60005	36

MODEL	CALICO P/N	ASSY R.O.
8440	8440-700	
TITLE	SHT 4 OF 6	
DIGITAL and ANALOG P.C. BOARD ASSY		A1

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1IC15	SN7402N	I. C.	27014	3-60001	37
A1IC16	SN7402N	I. C.	27014	3-60001	38
A1IC17	SN7400N	I. C.	27014	3-60000	39
					40
					41
					42
A1L1	2500-64	CHOKE 5600μH ±5%	99800	5-90047	43
					44
					45
A1Q1	MJE 340	TRANSISTOR	04713	3-30199	46
A1Q2	TIS 43	F. E. T.	01295	3-30131	47
A1Q3	CIC 341	TRANSISTOR	16067	3-30184	48
A1Q4	MJE 340	TRANSISTOR	04713	3-30199	49
A1Q5	MJE 340	TRANSISTOR	04713	3030199	50
A1Q6	CIC 341	TRANSISTOR	16067	3-30184	51
					52
					53
					54
					55
					56
A1R1	RC07GF223J	RESISTOR 22K 5% 1/4W	81349	5-10084	57
A1R2	RC07GF223J	RESISTOR 22K 5% 1/4W	81349	5-10084	58
A1R3	RC07GF223J	RESISTOR 22K 5% 1/4W	81349	5-10084	59
A1R4	RC07GF223J	RESISTOR 22K 5% 1/4W	81349	5-10084	60
A1R5	RC07GF473J	RESISTOR 47K 5% 1/4W	81349	5-10092	61
A1R6	RC07GF104J	RESISTOR 100K 5% 1/4W	81349	5-10100	62
A1R7	RC07GF202J	RESISTOR 2K 5% 1/4W	81349	5-10059	63
A1R8	RC07GF202J	RESISTOR 2K 5% 1/4W	81349	5-10059	64
A1R9	RC07GF202J	RESISTOR 2K 5% 1/4W	81349	5-10059	65
A1R10	RC07GF104J	RESISTOR 100K 5% 1/4W	81349	5-10100	66
A1R11		RESISTOR T.B.D.	81349		67
A1R12	RC07GF102J	RESISTOR 1K 5% 1/4W	81349	5-10053	68
A1R13	RC07GF103J	RESISTOR 10K 5% 1/4W	81349	5-10076	69
A1R14	RC07GF202J	RESISTOR 2K 5% 1/4W	81349	5-10059	70
A1R15	RC07GF102J	RESISTOR 1K 5% 1/4W	81349	5-10053	71
A1R16	RC07GF473J	RESISTOR 47K 5% 1/4W	81349	5-10092	72

MODEL 8440 — CALICO P/N 8440-700 — ASSY R.O.

TITLE DIGITAL and LOGIC P.C. BOARD ASSY — SHT 5 OF 6 — A1

CALICO — CALIFORNIA INSTRUMENTS CORP., SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R17	RC07GF202J	RESISTOR 2K 5% 1/4W	81349	5-10059	73
					74
					75
					76
	RCT018110-1A	TRANSIPAD, TO-18	19080	2-40297	77
					78
					79
	24 AWG	BUSS WIRE			80
	24 AWG	TEFLON SLEEVING			81
					82
	7/8 x 1 5/8	.003 MYLAR SHEET			83
					84
	#77	SPRAY ADHESIVE	04963		85
					86
					87
	60-8200-02-13-00-011	ELCO PINS	91662	4-10161	88

MODEL 8440 | CALICO P/N 8440-700 | ASSY REV A1

TITLE DIGITAL and LOGIC P.C. BOARD ASSY | SHT 6 OF 6

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2	8440-701-1	ANALOG ASSY	16067		1
	-7	P. C. BOARD	16067	1-60105	2
					3
					4
					5
A2C1	CK502	CAPACITOR .005μF 50V	71590	6-10078	6
A2C2	CM05F221J03	CAPACITOR 220 PF 500V	81349	6-10036	7
A2C3	CK502	CAPACITOR .005μF 50V	71590	6-10078	8
A2C4	CM05F201J03	CAPACITOR 200PF 500V	81349	6-10282	9
A2C5	PA2A224K	CAPACITOR .22μF 50V	27556	6-10740	10
A2C6	CK502	CAPACITOR .005μF 50V	71590	6-10078	11
A2C7	CM05F201J03	CAPACITOR 200PF 500V	81349	6-10282	12
A2C8	CK502	CAPACITOR .005μF 50V	71590	6-10078	13
A2C9	5HK-D10	CAPACITOR .001μF 1KV	71590	6-10062	14
A2C10	5HK-D10	CAPACITOR .001μF 1KV	71590	6-10062	15
A2C11	5HK-D10	CAPACITOR .001μF 1KV	71590	6-10062	16
A2C12	T360B106M025AS	CAPACITOR 10μF 25V	05397	6-10738	17
A2C13	T360B106M025AS	CAPACITOR 10μF 25V	05397	6-10738	18
					19
A2CR1	CIC-705	DIODE ZENER	16067	3-10197	20
A2CR2	IN914	DIODE	81349	3-10118	21
A2CR3	IN914	DIODE	81349	3-10118	22
A2CR4	IN914	DIODE	81349	3-10118	23
A2CR5	IN914	DIODE	81349	3-10118	24
A2CR6	IN914	DIODE	81349	3-10118	25
					26
					27
					28
A2IC1	CIC200-2	I. C.	16067	3-30006	29
A2IC2	CIC200-2	I. C.	16067	3-30006	30
A2IC3	811CE	I. C.	15818	3-30128	31
A2IC4	CIC200-2	I. C.	16067	3-30006	32
A2IC5	CIC200-3	I. C.	16067	3-60006	33
A2IC6	CIC200-3	I. C.	16067	3-60006	34
A2IC7	CIC200-3	I. C.	16067	3-60006	35
A2IC8	CIC200-3	I. C.	16067	3-60006	36

MODEL	CALICO P/N		ASSY R.O.
8440	8440-701	D	
TITLE		SHT OF	
ANALOG P. C. BOARD ASSY		4 6	A2

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2IC9	SN7402N	I. C.	27014	3-60001	37
A2IC10	SN7402N	I. C.	27014	3-60001	38
A2IC11	SN7404N	I. C.	27014	3-60002	39
A2IC12	SN7402N	I. C.	27014	3-60001	40
A2IC13	SN7402N	I. C.	27014	3-60001	41
					42
A2L1	1537-90	COIL, 200 μH	99800	5-90005	43
A2L2	1537-90	COIL, 200 μH	99800	5-90005	44
A2Q1	CIC 336	TRANSISTOR, DUAL	16067	3-30015	45
A2Q2	CIC 341	TRANSISTOR	16067	3-30184	46
A2Q3	U1899E	F. E. T.	15818	3-30196	47
A2Q4	U1899E	F. E. T.	15818	3-30196	48
A2Q5	U1899E	F. E. T.	15818	3-30196	49
A2Q6	U1899E	F. E. T.	15818	3-30196	50
					51
					52
					53
A2R1	RCO7GF102J	RESISTOR 1K 5% 1/4W	81349	5-10053	54
A2R2	RCO7GF106J	RESISTOR 10M 5% 1/4W	81349	5-10135	55
A2R3	RC07GF106J	RESISTOR 10M 5% 1/4W	81349	5-10135	56
A2R4	RCO7GF104J	RESISTOR 100K 5% 1/4W	81349	5-10100	57
A2R5	MK 14	RESISTOR 1.333K .01% 1/8W	17838	5-80143	58
A2R6	RCO7GF150J	RESISTOR 15Ω 5% 1/4W	81349	5-10009	59
A2R7	RCO7GF152J	RESISTOR 1.5K 5% 1/4W	81349	5-10057	60
A2R8	RCO7GF152J	RESISTOR 1.5K 5% 1/4W	81349	5-10057	61
A2R9	RCO7GF202J	RESISTOR 2K 5% 1/4W	81349	5-10059	62
A2R10	RCO7GF201J	RESISTOR 200Ω 5% 1/4W	81349	5-10036	63
A2R11	RCO7GF201J	RESISTOR 200Ω 5% 1/4W	81349	5-10036	64
A2R12	RCO7GF202J	RESISTOR 2K 5% 1/4W	81349	5-10059	65
A2R13	RCO7GF512J	RESISTOR 5.1K 5% 1/4W	81349	5-10069	66
A2R14	MK14	RESISTOR 10K .01% 1/8 W	17838	5-80148	67
A2R15	RCO7GF105J	RESISTOR 1M 5% 1/4W	81349	5-10123	68
A2R16	RCO7GF103J	RESISTOR 10K 5% 1/4W	81349	5-10076	69
A2R17	RN60D4423F	RESISTOR 442K 1% 1/4W	81349	5-60190	70
A2R18	RCO7GF472J	RESISTOR 4.7K 5% 1/4W	81349	5-10068	71
A2R19	MK14	RESISTOR 9.975K .01% 1/8W	17838	5-80144	72

MODEL 8440 — CALICO P/N 8440-701 — C — ASSY R.O.

TITLE ANALOG P. C. BOARD ASSY — SHT 5 OF 6 — A2

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2R20	RCO7GF103J	RESISTOR 10K 5% 1/4W	81349	5-10076	73
A2R21	RCO7GF152J	RESISTOR 1.5K 5% 1/4W	81349	5-10057	74
A2R22	RCO7GF202J	RESISTOR 2K 5% 1/4W	81349	5-10059	75
A2R23	RCO7GF102J	RESISTOR 1K 5% 1/4W	81349	5-10053	76
A2R24	RCO7GF242J	RESISTOR 2.4K 5% 1/4W	81349	5-10061	77
A2R25	RCO7GF104J	RESISTOR 100K 5% 1/4W	81349	5-10100	78
A2R26	RCO7GF104J	RESISTOR 100K 5% 1/4W	81349	5-10100	79
A2R27	RCO7GF104J	RESISTOR 100K 5% 1/4W	81349	5-10100	80
A2R28	RCO7GF104J	RESISTOR 100K 5% 1/4W	81349	5-10100	81
A2R29	RCO7GF302J	RESISTOR 3K 5% 1/4W	81349	5-10063	82
A2R30	RCO7GF202J	RESISTOR 2K 5% 1/4W	81349	5-10059	83
					84
					85
					86
					87
					88
A2T1	B8440-011-1	TRANSFORMER	16067	7-10199	89
A2T2	B8440-011-1	TRANSFORMER	16067	7-10199	90
A2T3	B8440-011-1	TRANSFORMER	16067	7-10199	91
A2T4	B8440-011-1	TRANSFORMER	16067	7-10199	92
					93
					94
	B8440-705-7	SHIELD	16067	1-60112	95
	RCT018110-1A	TRANSIPAD	19080	2-40297	96
					97
					98
	4-40 x 5/16 Lg.	SCREW, PAN HD.			99
					100
	#4	WASHER, INT. STR.			101
					102
	#4-40 x 3/16	NUT, HEX			103
					104
	24 AWG	BUSS WIRE			105
	24 AWG	TEFLON SLEEVING			106
					107
					108

MODEL 8440 — CALICO P/N 8440-701 C — ASSY R.O.

TITLE ANALOG P.C. BOARD ASSY — SHT 6 OF 6 — A2

CALICO	CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA	CODE IDENT 16067	PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A3	8440-702-1	POWER SUPPLY ASSY	16067		1
	-7	P.C. BOARD	16067	1-60106	2
	EYELET	SEE SHEET 3			3
	8440-702-2	POWER SUPPLY ASS'Y	16067		4
					5
A3C1	5GAS-S10	CAPACITOR .01μF 500V	56289	6-10778	6
A3C2	5GAS-S10	CAPACITOR .01μF 500V	56289	6-10778	7
A3C3	39D257G050HE4	CAPACITOR 250μF 50V	56289	6-10495	8
A3C4	39D257G050HE4	CAPACITOR 250μF 50V	56289	6-10495	9
A3C5	BR3000-15	CAPACITOR 3000μF 15V	14655	6-10594	10
A3C6	BR1000-15	CAPACITOR 1000μF 15V	14655	6-10401	11
A3C7	T360B106M025AS	CAPACITOR 10μF 25V	05397	6-10738	12
A3C8	T360B106M025AS	CAPACITOR 10μF 25V	05397	6-10738	13
A3C9	T360B106M025AS	CAPACITOR 10μF 25V	05397	6-10738	14
A3C10	T360B106M025AS	CAPACITOR 10μF 25V	05397	6-10738	15
A3C11	WMF 251	CAPACITOR .01μF 200V	14655	6-10091	16
					17
					18
A3CR1	SCE-4	DIODE	14099	3-10084	19
A3CR2	SCE-2	DIODE	14099	3-10079	20
A3CR3	SCE-2	DIODE	14099	3-10079	21
A3CR4	SCE-2	DIODE	14099	3-10079	22
A3CR5	SCE-2	DIODE	14099	3-10079	23
A3CR6	SCE-2	DIODE	14099	3-10079	24
A3CR7	SCE-2	DIODE	14099	3-10079	25
A3CR8	SCE-2	DIODE	14099	3-10079	26
A3CR9	SCE-2	DIODE	14099	3-10079	27
A3CR10	SCE-2	DIODE	14099	3-10079	28
A3CR11	SCE-2	DIODE	14099	3-10079	29
A3CR12	SCE-2	DIODE	14099	3-10079	30
A3CR13	SCE-2	DIODE	14099	3-10079	31
A3CR14	1N5245	DIODE, ZENER	04713	3-10067	32
A3CR15	1N5247	DIODE, ZENER	04713	3-10205	33
					34
A3DS1	PLN-100	LAMP, NEON	95416	2-50134	35
A3L1	2500-46	CHOKE 2.4mH	99800	5-90048	36

MODEL 8440	CALICO P/N 8440-702		ASSY R.O.
TITLE POWER SUPPLY P.C. BOAD ASSY		SHT 4 OF 5	A3

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A3L2	2500-46	CHOKE 2.4 mH	99800	5-90048	37
					38
A3Q1	2N 2102	TRANSISTOR	81349	3-30075	39
A3Q2	2N 4036	TRANSISTOR	81349	3-30106	40
					41
					42
					43
A3R1	4030	RESISTOR 1Ω 1 1/2W	44655	5-50106	44
A3R2	RC20GF101J	RESISTOR 100Ω 5% 1/2W	81349	5-20018	45
A3R3	RC07GF182J	RESISTOR 1.8K 5% 1/4W	81349	5-10058	46
A3R4	RC07GF182J	RESISTOR 1.8K 5% 1/4W	81349	5-10058	47
A3R5	RC20GF101J	RESISTOR 100Ω 5% 1/2W	81349	5-20018	48
A3R6	RC07GF223J	RESISTOR 22K 5% 1/4W	81349	5-10084	49
					50
					51
A3T1	A8440-010-1	TRANSFORMER	16067	7-10198	52
*	B8440-203-7	BRACKET, TRANSFORMER	16067	1-10197	53
	*ITEM 53 IS PART OF A3T1				54
A3VR1	LM309K	VOLTAGE REGULATOR	27014	3-60007	55
A3VR2	LM309K	VOLTAGE REGULATOR	27014	3-60007	56
	AWG22	BUS WIRE			57
	AWG22	TEFLON SLEEVING			58
	B8440-201-1	PLATE-VOLTAGE REG.	16067	1-10195	59
	4-40 x 5/16 LG	SCREW, PAN HD.			60
	#4 x 1/4 Lg. TYPE B	SCREW, SELF TAP, PAN HD.	45722	2-10289	61
	2374	STANDOFF, 4-40 THD	83330	2-10025	62
	#4-40 x 5/16 Lg	SCREW, FLAT HD.			63
	#4	WASHER, INT. STR.			64
	SW-4-BLK	SHOULDER WASHER	75987	2-10266	65
	1412-4	SOLDER LUG	83330	2-50115	66
	DM-101	MICA INSULATOR	08289	2-10315	67
	RG-174/U	CABLE, COAX	81349		68
	4-40	NUT, HEX			69
	RCT05075-7A	TRANSIPAD, TO-5	19080	2-40296	70
					71
	NW4-2812	NYLON WASHER, #4	75987	2-10142	72

MODEL	8440	CALICO P/N 8440-702	ASSY R.O.
TITLE	POWER SUPPLY P.C. BOARD ASSY	SHT 5 OF 5	A3

CALICO — CALIFORNIA INSTRUMENTS CORP., SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A4	8440-703-1	PREAMPLIFIER 1.5V DC	16067		1
A4	8440-703-2	PREAMPLIFIER 15V DC	16067		2
A4	8440-703-3	PREAMPLIFIER 150V DC	16067		3
	-7	P.C. BOARD	16067	1-60113	4
	SEE SHEET 3	EYELET			5
					6
					7
					8
A4C1	1DDP-1-203	CAPACITOR .02μF 100V	04062	6-10100	9
A4C2	CK502	CAPACITOR .005μF 50V	71590	6-10078	10
A4C3	CM05F201J03	CAPACITOR 200PF 500V	04062	6-10282	11
					12
					13
A4CR1	IN5234A	DIODE ZENER	04713	3-10130	14
A4CR2	IN5234A	DIODE ZENER	04713	3-10130	15
A4CR3	IN914	DIODE	81349	3-10118	16
A4CR4	IN914	DIODE	81349	3-10118	17
					18
					19
A4IC1	LM310	I.C.	27014	3-60011	20
A4IC2	CIC 225 ⟨1⟩	I.C.	16067	3-60008	21
					22
					23
A4Q1	CIC 225 ⟨1⟩	F.E.T.	16067	3-60008	24
					25
					26
A4R1A	RC07GF104J	RESISTOR 100K 5% 1/4W	81349	5-10100	27
A4R1B	CIC 504-1 ⟨2⟩	RESISTOR 9M 1%	16067	5-80145	28
A4R1C	CIC 504-2 ⟨3⟩	RESISTOR 9.9M 1%	16067	5-80146	29
A4R2A	NOT USED				30
A4R2B	CIC 504-1 ⟨2⟩	RESISTOR 1M 1%	16067	5-80145	31
A4R2C	CIC 504-2 ⟨3⟩	RESISTOR 100K 1%	16067	5-80146	32
A4R3	ET34P500	POTENTIOMETER 50Ω	30983	5-70130	33
A4R4	CIC 225 ⟨1⟩	RESISTOR	16067	3-60008	34
A4R5	RN60C6042F	RESISTOR 60.4K .5% 1/8W	81349	5-60433	35
A4R6	MK14	RESISTOR 1K .1% 1/8W	17838	5-80154	36

MODEL	CALICO P/N	ASSY R.O.
8440	8440-703	
TITLE	SHT 4 OF 5	
PREAMPLIFIER P.C. BOARD ASSY		A4

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A4R7	RC07GF202J	RESISTOR 2K 5% 1/4W	81349	5-10059	37
A4R8	RN60D2260F	RESISTOR 226Ω 1% 1/4W	81349	5-60432	38
A4R9	ET34P500	POTENTIOMETER 50Ω	30983	5-70130	39
A4R10	RN60C6042F	RESISTOR 60.4K .5% 1/8W	81349	5-60433	40
A4R11	RC07GF202J	RESISTOR 2K 5% 1/4W	81349	5-10059	41
A4R12	MK14	RESISTOR 5.15K .1% 1/8W	17838	5-80155	42
A4R13	RC07GF152J	RESISTOR 1.5K 5% 1/4W	81349	5-10057	43
A4R14	RN60D	RESISTOR T.B.D. 1% 1/4W	81349		44
A4R15	ET34P500	POTENTIOMETER 50Ω	30983	5-70130	45
A4R16	RC07GF102J	RESISTOR 1K 5% 1/4W	81349	5-10053	46
					47
					48
	62-5101-40-12	CARD GUIDE	91662	2-10311	49
	90-2168-00-14-01	RIVET	91662	2-10312	50
					51
					52
	22 AWG	BUSS WIRE			53
	FOR 22GA WIRE	TEFLON SLEEVING			54
					55
					56
	B8440-202-7	NAME PLATE	16067	1-10196	57
	SILK SCREEN AS SPECIFIED IN ERA				58
					59
					60
					61
					62

NOTE:

1. A4IC2 and A4Q1 are a matched set.
2. A4R1B and A4R2B are a matched set.
3. A4R1C and A4R2C are a matched set.

MODEL	CALICO P/N	ASSY R.O.
8440	8440-703	A4
TITLE: PREAMPLIFIER P.C. BOARD ASSY	SHT 5 OF 5	

CALICO — CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA — CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A5	8440-704-1	OVERRANGE BD. ASS'Y	16067		1
					2
	8440-704-7	OVERRANGE BD.	16067	1-60111	3
					4
A5DS1	B8350-012-7	LAMP, NEON	16067	2-41082	5
A5DS2	A-261	LAMP, NEON	74276	2-41081	6
					7
					8
A5R1	RC07GF474J	RESISTOR 470K 1/4W 5%	81349	5-10115	9
A5R2	RC07GF474J	RESISTOR 470K 1/4W 5%	81349	5-10115	10
					11
	8420-100	DECAL, NEON	16067	2-10355	12
					13
	24 AWG	BUSS WIRE			14
					15
	60-8240-03-03-00-011	ELCO PIHS	91662	4-10160	16

MODEL 8440 — CALICO P N 8440-704 — ASSY R.O. A5

TITLE OVERRANGE BOARD ASS'Y — SHT 4 OF 4

APPENDIX A

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-1 and its latest supplement. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbook.

0000A	ElectriCord	Westfield, Pa.
0000B	Tech. Prod. Sales	Sorrento Valley, Ca.
0000C	Jackson Bros.	Waddon, Surrey, England
0000D	Chicago Std. Transformer Co.	Chicago, Ill.
0000E	Use Code #08289	
0000F	Colvern	Santa Monica, Ca.
0000G	Use Code #30983	
0000H	Mial Of Italy c/o Q. C. Components	Los Angeles, Ca.
00001	Monsanto, Electronic Special Products	Cupertino, Ca.
0000J	Silicon General	Los Angeles, Ca.
0000K	Elma	Schweiz, Germany
0000L	Intersil	Cupertino, Ca.
0000M	Precision Dynamics Corp.	Burbank, Ca.
00141	Pic Design Corp.	E. Rockaway, N. Y.
00544	Metal-Cal Div, Avery Prod. Corp.	Inglewood, Ca.
00656	Aerovox Corporation	New Bedford, Mass.
00779	AMP, Inc.	Harrisburg, Pa.
00853	Sangamo Electric Company	Pickens, S. C.
00866	Goe Eng. Co., Inc.	City of Industry, Ca.
01121	Allen-Bradley Company	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Ca.
01281	T R W Semiconductors, Inc.	Lawndale, Ca.
01295	Texas Instruments, Inc.	Dallas, Tex.
02111	Spectrol Electronics	City of Industry, Ca.
02114	Ferroxcube Corp.	Saugerties, N. Y.
02335	Fairchild Controls Corp.	Hicksville, LI, N. Y.
02660	Amphenol Corporation	Broadview, Ill.
02799	Use Code #72136	
03507	General Electric Company	Syracuse, N. Y.
03508	General Electric Company	Syracuse, N. Y.
03516	General Electric Company	Somersworth, N. H.
03797	Eldema Corporation	Compton, Ca.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N. J.
03911	Clairex Corporation	New York, N. Y.
04009	Arrow-Hart and Hegeman Elec. Co.	Hartford, Ct.
04062	Use Code #72136	
04713	Motorola Semiconductor Prod., Inc.	Phoenix, Ariz.
04963	3-M	St. Paul, Minn.
05276	Pomona Electronics Co., Inc.	Pomona, Ca.
05397	Kemet, Union Carbide Corp.	Cleveland, Ohio
05820	Wakefield Engineering, Inc.	Wakefield, Mass.
06184	Conelco Components	San Bernadino, Ca.
06223	Kooltronic Fan Company	Princeton, N. J.
06229	Electrovert, Incorporated	Mt. Vernon, N. Y.
06514	Stantron, Wyco Metal Products	N. Hollywood, Ca.
06540	Amathom Elect. Hardward	New Rochelle, N. Y.
06682	Magnetic Shield Div.	Chicago, Ill.
07088	Kelvin Electric Company	Van Nuys, Ca.
07256	Silicon Transistor Corp.	Garden City, N. Y.
07263	Fairchild Camera and Instr. Corp.	Mt. View, Ca.
07387	Birtcher Corporation	Los Angeles, Ca.
07556	Unitrack, Calabro Plastics	Upper Darby, Pa.
07716	I R C, Incorporated	Burrington, Iowa
07910	Continental Devices	Hawthorne, Ca.
08065	Accurate Rubber and Plastics Co.	San Diego, Ca.
08261	Spectra Strip	Garden Grove, Ca.
08289	Blinn-Delbert Co., Inc.	Pomona, Ca.
08718	Use Code #71468	
08730	Vemaline Products Co.	Franklin Lakes, N. J.
09026	Babcock Electronics Corp.	Costa Mesa, Ca.
09145	Atohm, Technical Industries, Inc.	Burbank, Ca.
09353	C and K Components, Inc.	Newton, Mass.
11432	Diamond Metal Sales	Gardena, Ca.
11815	Cherry Rivet Div., Townsend Co.	Santa Ana, Ca.
12020	Ovenaire, Incorporated	Charlottesville, Va.
12143	Bendix Corporation	Santa Ana, Ca.
12405	Hysol Corporation	El Monte, Ca.
12406	Elpac, Incorporated	Fullerton, Ca.
12463	Omtronics Mfg., Incorporated	Omaha, Neb.
12697	Clarostat Mfg. Co., Incorporated	Dover, N. H.
13103	Thermalloy Company	Dallas, Tex.
13454	Texas Crystals	River Grove, Ill.
14099	Semtech Corporation	Newbury Park, Ca.
14655	Cornell-Dubilier Elect. Corp.	Newark, N. J.
14726	Hollingsworth Co.	Phoenixville, Pa.
14752	Electro Cube, Incorporated	San Gabriel, Ca.
15112	Electra Scientific Corporation	Fullerton, Ca.
15801	Fenwall Electronics	Framingham, Mass.
15818	Amelco, Teledyne, Incorporated	Mt. View, Ca.
15909	Use Code #17870	
15912	Digital Sensors, Incorporated	Los Angeles, Ca.
16067	California Instruments Company	San Diego, Ca.
16758	Delco Radio Div., General Motors	Kokomo, Ind.
16902	Simpson Instruments, Inc.	Escondido, Ca.
17745	Angstrohm Precision, Inc.	Van Nuys, Ca.
17838	Mektron, California General, Inc.	Chula Vista, Ca.
17870	Daven Div., Thomas A. Edison	Manchester, N. H.
18076	Umpco	City of Industry, Ca.
18121	Wilshire Foam Products, Inc.	Gardena, Ca.
18178	Vactec Inc.	Maryland Heights, Mo.
18324	Signatics	Sunnyvale, Ca.
18612	Vishay Instruments Inc.	Malvern, Pa.
18677	Scambe Mfg. Co.	Monterey Park, Ca.
18702	Ducommun Metals and Supply Co.	Los Angeles, Ca.
18722	R C A	Mountaintop, Pa.
19080	The Robinson Company	Hawthorne, Ca.
19781	Potter Company	Sun Valley, Ca.
20857	South Bay Cable Corp.	Gardena, Ca.
21604	Buckeye Stamping Company	Columbus, Ohio
22599	Elastic Stop Nut Corporation	Van Nuys, Ca.
23039	Deccofelt Products Company	Glendora, Ca.
23050	Product Components Corp.	Hastings-on-Hudson, N. Y.
23783	British Radio Electric Ltd.	Washington, D. C.
23936	Pamotor, Incorporated	San Francisco, Ca.
24796	Parelco Inc.	Paramount, Ca.
24931	Specialty Connector Co., Inc.	Indianapolis, Ind.
25684	Victoreen Instrument Co., Inc.	Oak Lawn, Ill.
25706	Daburn Electronics and Cable Corp.	New York, N. Y.
26528	Lamcor, Incorporated	Anaheim, Ca.
26533	Zero Manufacturing Company	Burbank, Ca.
27014	National Semi-Conductor Corp.	Santa Clara, Ca.
27191	Cutler-Hammer, Inc.	Milwaukee, Wisc.
27556	IMB Electronic Products	Santa Fe Springs, Ca.
27683	Varo, Incorporated	St. Garland, Tex.
28480	Hewlett-Packard Co.	Palo Alto, Ca.
28520	Heyman Mfg. Company (Heyco)	Kenilworth, N. J.
30086	I-T-E Circuit Breaker Co.	Philadelphia, Pa.
30817	Instrument Specialties Co.	Little Falls, N. J.
30983	Electra/Midland	San Diego, Ca.
42190	Muter Company	Chicago, Ill.
44655	Ohmite Manufacturing Company	Skokie, Ill.
45722	Parker-Kalon	Clifton, N. J.
46384	Penn. Eng. and Mfg. Corp.	Doylestown, Pa.
56289	Sprague Electric Company	North Adams, Mass.
58474	Superior Electric Company	Bristol, Ct.
59730	Thomas and Betts Company	Elizabeth, N. J.
60741	Triplett Electrical Instrument Co.	Bluffton, Ohio
63743	Ward Leonard Electric Co.	Mt. Vernon, N. Y.
70903	Belden Manufacturing Co.	Chicago, Ill.
71002	Birnbach Radio Company, Inc.	New York, N. Y.
71279	Cambridge Thermionic Corp.	Cambridge, Mass.
71400	Bussmann Mfg. Div., McGraw-Edison Co.	St. Louis, Mo.
71450	CTS Corporation	Elkhart, Ind.
71468	ITT Cannon Electric, Inc.	Los Angeles, Ca.
71590	Centralab Div., Globe-Union, Inc.	Milwaukee, Wis.
71744	Chicago Miniature Lampworks	Chicago, Ill.
71785	Cinch Manufacturing Company	Chicago, Ill.
72136	Elmenco (Electro Motive)	Willimantic, Ct.
72259	Nytronics, Incorporated	Berkeley Heights, N. J.
72619	Dialight Corporation	Brooklyn, N. Y.
72982	Erie Technological Products, Inc.	Erie, Pa.
73138	Beckman Instruments, Inc.	Fullerton, Ca.
73559	Carling Electric, Inc.	West Hartford, Ct.
73734	Federal Screw Products, Inc.	Chicago, Ill.
73899	J F D Electroncis Company	Brooklyn, N. Y.
73949	Guardian Electric Mfg. Co.	Chicago, Ill.
73957	Groov-Pin Corporation	Ridgefield, N. J.
74193	Heinemann Electric Company	Trenton, N. J.
74276	Signalite, Incorporated	Neptune, N. J.
74542	Hoyt Electrical Instrument Works	Penacook, N. H.
74545	Harvey Hubbel, Inc.	Bridgeport, Ct.
74970	E. F. Johnson Company	Waseca, Minn.
75382	Kulka Electric Corporation	Mt. Vernon, N. Y.
75915	Littelfuse, Incorporated	Des Plaines, Ill.
75987	Use Code #95987	
76055	Mallory Controls	Frankfort, Ind.
76348	Miller Products Company	New York, N. Y.
76493	J. W. Miller Company	Los Angeles, Ca.
76854	Oak Manufacturing Company	Crystal Lake, Ill.
77342	Potter and Brumfield Div., Amer. Machine and Foundry Company	E. Princeton, Ind.
78189	Shakeproof Div., Illoms Tool Works	Chicago, Ill.
78299	Struthers-Dunn, Incorporated	Pitman, N. J.
78488	Stackpole Carbon Company	St. Marys, Pa.
78526	Stanwyck Winding Company, Inc.	Newburgh, N. Y.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78947	Ucinite Company	Newtonville, Mass.
79130	Johns-Manville Products Corp.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Phila., Pa.
79963	Zierick Mfg. Corporation	New Rochelle, N. Y.
80112	G. C. Electronics Company	Los Angeles, Ca.
80223	United Transformer Co.	New York, N. Y.
80294	Bourns, Incorporated	Riverside, Ca.
80368	Sylvania Electric Products, Inc.	New York, N. Y.
81073	Grayhill, Incorporated	La Grange, Ill.
81095	Triad Transformer Corp.	Venice, Ca.
81312	Winchester Electronics	Oakville, Ct.
81349	Military Spec., Standardization Division, Directorate of Logistic Services DSA	
82389	Switchcraft, Incorporated	Chicago, Ill.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N. Y.
83058	Car Fastener Company	Cambridge, Mass.
83324	Rosan, Incorporated	Newport Beach, Ca.
83330	Herman H. Smith, Inc.	Brooklyn, N. Y.
83594	Burroughs Corporation	Plainfield, N. J.
83701	Electronic Devices, Incorporated	Yonkers, N. Y.
84171	Arco Electronics, Inc.	Great Neck, N. Y.
86684	R C A	Harrison, N. J.
87034	Marco-Oak Industries	Anaheim, Ca.
88026	Use Code #27191	
88245	Useco Div., Litton Industries	Van Nuys, Ca.
90201	Mallory Capacitor Company	Indianapolis, Ind.
91637	Dale Electronics, Inc.	Columbus, Neb.
91662	Elco Corporation	Willow Grove, Pa.
91812	Janco Corporation	Burbank, Ca.
91833	Keystone Electronics Corp.	New York, N. Y.
91929	Micro Switch Div., Honeywell, Inc.	Freeport, Ill.
92194	Alpha Wire Corporation	Elizabeth, N. J.
92219	Waldom Electronics, Inc.	Chicago, Ill.
93332	Sylvania Electric Products, Inc.	Woburn, Mass.
94222	Southco, Incorporated	Lester, Pa.
95146	Alco Electronics Products	Lawrence, Mass.
95303	R C A	Cincinnati, Ohio
95416	Use Code #95146	
95987	Weckesser Company, Inc.	Chicago, Ill.
96682	Genisco, Incorporated	Compton, Ca.
97525	Electronic Engineering Co.	Santa Ana, Ca.
97954	U. S. Components, Incorporated	Bronx, N. Y.
98159	Rubber Teck, Incorporated	Gardena, Ca.
98278	Microdot, Incorporated (Lerco)	S. Pasadena, Ca.
98978	IERC	Burbank, Ca.
99392	STM Corporation	Oakland, Ca.
99515	Marshall Industries	Monrovia, Ca.
99517	Vacco Industries	El Monte, Ca.
99800	Delevan Electronics Corporation	Aurora, N. Y.
99742	Permacel Div., Johnson and Johnson	New Brunswick, N. J.

E.E. LAB Copy

ONE YEAR WARRANTY

CALIFORNIA INSTRUMENTS COMPANY a division of AIKEN INDUSTRIES INC. warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS COMPANY will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned to the Company freight prepaid, and when examination reveals that the fault has not occurred because of misuse or abnormal conditions of operation. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALIFORNIA INSTRUMENTS COMPANY will submit an estimate for such charges before commencing repair if so requested.

PROCEDURE FOR SERVICE

If a fault develops, notify CALIFORNIA INSTRUMENTS COMPANY or its local representative, giving full details of the difficulty, and including the model number and serial number. On receipt of this information, service data or shipping instructions will be furnished. If shipment is indicated, forward the instrument, freight prepaid, to the authorized repair station indicated in the instruction. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. CALIFORNIA INSTRUMENTS COMPANY will advise the disposition to be made of the equipment and arrange for repair or replacement. Please include model number and serial number when referring to the instrument.

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